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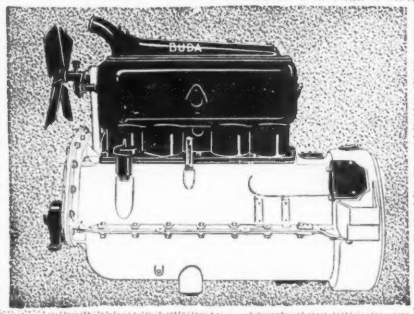
"LET US HAVE THE FACTS"—No. 12



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AUTOMOTIVE INDUSTRIES
THE AUTOMOBILE

VOL. XXXVIII NEW YORK—THURSDAY, JANUARY 3, 1918—CHICAGO NO. 1

Efficient Transportation Demanded of Engineers

Sharp Change of Practice Necessary to Eliminate Extravagance of Wheelbase and Engine Size

By J. Edward Schipper

ENGINEERING practice in passenger car work must make a sharp change. The war has brought us face to face with a condition which normally would not have been due for 3 yrs. During these 3 yrs. we would have changed gradually to meet the new state of affairs and normal trends would have carried us through without a break. We have suddenly awakened to the fact that automobiles are not efficient and not economical just at the same time that the people have been awakened by the trumpet call of war to the fact that our daily lives and habits, whether they are concerned with transportation or what not, must be efficient and economical.

The drop in automobile sales is not only because there is not as much money to spend in this country as heretofore, but people are watching more closely the results that they are securing for money expended. People are buying transportation and not automobiles. They measure the expenditure of money for a passenger car by the standards of transportation afforded by the car they buy. They want stability, flexibility, Pullman car comfort, reliability and all the qualities that go to make up good transportation, and above all economy.

Up to the time this country entered the war the people of the United States had been noted as being the most extravagant in the world. There has been a remarkable revulsion of feeling. A wave of economy has arrived. It has exerted its influence in the clothing we wear, in the things we eat, in the places we go to and above all in our transportation. It has exerted itself in the automobiles we buy.

For example: Walk along Automobile Row in any large city and look into the windows of the used car dealers. You see a most significant thing. Big cars which in 1915 sold new for $3,000 and $4,000 are selling for $300 and $400. A depreciation of 90 per cent in 3 yr., and why? Not because the cars are not good automobiles; not because they have not good materials; not because the bodies are out of date, but simply because they are not efficient.

Change in Demand Has Arrived

The extravagance of wheelbase, the extravagance of engine size, the extravagance of fancy metal fittings all built to meet the popular clamor of a public which through the very element of national wealth thought only in extremes. Now a change has arrived. We buy only what we can use. We are no longer patient of wastefulness, our country is at war and conservation must take the place of waste. Unconsciously we have swung around a 180 deg. arc in our national psychology.

This finds the engineering profession unprepared to a large extent. It is true that efficiency in transportation has been in the mind's eye of the engineer for a long time, but he has had to build a car to suit the public as interpreted by the sales department. This is natural enough, as cars must be built to sell.

His laboratory work and his engineering discussions have pointed out time and time again that what he would like to build and what the sales departments demand has been exemplified by the difference between sound and unsound engineering fundamentals.

The potential change in the public mind has been sensed but not realized and analyzed by the automobile sales departments, taking the industry as a whole. The drop in sales in certain cars has been interpreted in the commonplace words, "Business is bad," yet business, when transportation is being sold, is never bad. The article sold and the article demanded do not happen to fit.

There have been several clues to this situation. While the business of certain cars in the high-price class has fallen off, the business of other companies in the same field has remained almost at normal. The business of the companies selling lower-priced cars has been exceptional in certain parts of the country and in others has not dropped very seriously. In almost all territories a falling off in business has been directly traced to a tendency on the part of people who changed their cars every year or two, to keep these cars for an additional season or more. It is just another indication of the economy spirit.

Want Economical Transportation

People want economical transportation. If an article is wanted, it makes little difference what sort of a package it is wrapped in, and if the desired article of "economical transportation" comes wrapped in the shape of an automobile, it is not goingto scare away the buyers even though we are at war. Rather, with a universal tendency toward speeding up, it is going to be desired more than ever.

This brings the matter to the engineer. The sales department will quickly adjust itself to the new condition and this demand is sure to fall upon the engineer in turn. In a large measure the engineer is, as a class, prepared for it. If he has been thinking ahead 3 yrs. he is ready at least to logically analyze the problem that he has now before him.

In a large measure it cannot but be a relief to the engineering mind to feel that now a true advance is to be made in automobile engineering. It seems as if the big difficulty of the opposing demands of the public for a big car on the one hand a flexible car with plenty of get-away on the other seems to be passing away. The lesson of the used car just pointed out seems to establish that. The change has been complete even though it is not realized fully as yet by the public.

Where we have been led astray in an engineering way is quite clear. We have been what the public wanted us to be, extravagant. We have been extravagant of wheelbase, extravagant of engine size, extravagant of tonneau, extravagant from radiator to back end, simply to suit a public which asked not what kind of a car, but how much car for the money. Cars have been sold by the pound rather than by their capability of returning to the purchaser the worth of the price in good transportation.

In a great many ways it has been the fault of the industry, which has run with the tide against its better judgment. It is the industry which has led the campaign of high-gear performance, big engine displacement or horsepower, and above all, size.

From an analytical viewpoint we should focus our attention on two matters: wheelbase and displacement. Weight per inch of wheelbase can be materially reduced, it is true, by a scientific distribution of materials and by the use of the best in materials, but it is carrying space per inch of wheelbase, which in other words can also be expressed as pounds of car per pounds of passenger, that is more important. Why should a person buy a car that weighs 7 lb. per pound of passenger weight when it is possible to so design a car that performance will be better and the car weigh but 3 lb. per pound of passenger on a five-passenger car? It must be necessary to show a great gain in comfort or other features before it seems right to take a man's money for a product.

Wasteful Wheelbase

We have been wasteful of wheelbase because we have not economically used space. Every inch of unnecessary wheelbase means unnecessary weight. This in turn requires gasoline, oil and tire upkeep. One typical medium-priced car was shortened 7 in. in wheelbase 3 months ago. The car has equally as much room in the tonneau and 2 in. more room in the front compartment. This is one example of what can be done. It is not necessary to sacrifice space, but to utilize it.

We demand acceleration: To get it with a heavy car means that we must add weight to the engine and this again takes more of all the factors that work against economy. Why is there no real high-priced car on the market with a wheelbase around 112 in? Because the public would expect to see a big car for that money. This condition is going to change. The public is going to demand a car in which it can be shown that every dollar spent brings its return in car value either in direct transportation ability or in comfort. The public is willing to pay for its extra comfort and convenience when it travels by automobile in just the same way that it will pay for its extra comfort and convenience when it travels in a Pullman railroad car.

Explicit directions for shortening wheelbase cannot be given for every make of car because space is lost by different cars in different ways. This is because the wheelbase has been fixed before the car is laid out and is simply utilized because it is there. Almost universally engines are too large. It would be perfectly feasible to secure all the good performance that anyone could demand in a five-passenger car with an engine of 200 cu. in. piston displacement. An engine of this size, regardless of the number of cylinders used, would require but a short hood. Due to its light weight and small capacity the structural members which support it could be correspondingly reduced.

With an eye which was ever watchful to secure the most from every part in the car, to make every part do the duty of two or more, it would not be

any great feat to bring the weight of the finished product below the 2000-lb. mark rather than above it. This could be done with plenty of space in the front compartment and tonneau. If the car is to be an expensive one the extra expense will go into comfort and endurance due to the choice of the finest materials and the most careful workmanship. The trimming, upholstery and painting work can reflect the excellence of the equipment and artistry in the vehicle.

Talking Horsepower

Perhaps one of the greatest errors the sales department has injected into the industry is the matter of talking horsepower. It has led indirectly to our use of large engines, whereas horsepower means nothing. It is the combined units of engine torque, gear ratio and car weight which spell the story of performance. The demand for acceleration and hill-climbing ability will always remain with the American public on account of our lack of long, straight, level roads. It is part of the American psychology also to demand that getaway. Attempts to educate the public to gear-changing have failed and probably never will succeed.

Reserve torque is what is demanded and not horsepower, but the exaggeration of the catalog writer has led the layman to believe that if he has an engine of high maximum power under the hood, he has an engine which will enable him to get away faster than other cars which have smaller engines. He does not even think of the other factors of torque, weight and gear ratio.

On page 5 are reproduced some curves which bring out clearly the wide variations in existing types of cars. If these curves are taken as a basis of thought and analysis in connection with the present demand for the ultimate in performance as well as economy the public will part with some of its craving for ultra-long wheelbases and other weight-creating elements. It can have the very kind of transportation it wants with minimum first cost and with minimum upkeep.

There is no doubt that the greatest demand for torque occurs between car speeds of from 14 to 25 miles per hour. The praiseworthy effort to so design the engine that the torque curve rises high and remains flat during this zone, must be continued. The available engine torque is a direct measure of the accelerative power and hill-climbing ability of the car. It is not complete in itself, however, as car weight must also be a factor.

The curves herewith illustrate this point: They show four up-to-date cars, of four, six, eight and twelve-cylinder designs—the actual torque curves of the engines plotted against a speed of miles per hour of the car. These curves show the torques in pounds-feet at the different car speeds and, of course, take in the factor of gear ratio, which would not be concerned were the engine torque plotted alone against r.p.m. In other words, these curves represent the effective torque of the engine at the rear wheels, the size of the wheel also being considered as effecting the final reduction between the engine and the propulsive member.

As a further indication of car performance, these same curves were taken and the weight factor of the car included. The dotted lines illustrate these final curves and are the actual measurement of what can be expected from these four types of cars in definite speed zones.

Probably as interesting a comparison as it is possible to make from the curves herewith given is that between the twelve cylinder and the six. In the actual plotting of torque in pounds-feet, the curve C of the twelve-cylinder engine is higher than that of curve A of the six-cylinder engine for almost its entire length. This would naturally be affected as the displacements are 42.41 for the twelve-cylinder and 288.6 for the six cylinder.

Owing to the fact, however, that the weight of the twelve is more than 1000 lb. heavier than that of the six, 4375 as against 3214, and owing to a slight advance in gear ratio, the indicated accelerative ability of the six surpasses that of the twelve at 19 m.p.h. In the zone between 10 and 19 m.p.h. the twelve-cylinder engine is considerably higher. Thus it would be expected that if high gear were used on both cars the twelve-cylinder car would show a marked advance in get-away at the lower speeds. This is not due to the number of cylinders, but simply to the torque-weight-ratio relationship.

The little four-cylinder engine shown at curve D has an exceptionally flat torque curve and represents what might be called typical effort to secure the highest possible torque as early as possible in the range of speeds. The maximum torque of this engine is reached at a car speed of about 30 m.p.h. At this time about 73 lb.-ft. of turning energy are available. More than 80 per cent of this torque is available at a car speed of only 8 m.p.h.

Torque Curve of Eight-Cylinder

The torque curve of the eight-cylinder engine is another which may be commented upon for its flatness. It is not, however, so flat as that of the twelve or four in lower ranges of car speed. This shows up particularly on the weight ratios. Naturally a direct comparison cannot be made on these four engines from an output standpoint because of the difference in displacement. On the other hand, these series of curves tends to show the difference in torque to car-weight ratio, and hence gives a direct measure of what may be expected from typical designs.

The connection between the flat torque curve in the early speed ranges and the high-efficiency, high-speed engine has not been brought home. The city driver appreciates being able to throttle down in traffic and at the same time without a change of gear to accelerate up to his speed-limit of 20 m.p.h. This means that the torque curve has got to be high within that range and also that the torque to weight ratio must be high. The terms of engine efficiency and engine ability are often confused. It is quite possible for an engine of low efficiency to have a high ability and the torque curve is no measure of efficiency.

This method of analysis is a key to one of the phases of the situation which confronts us. If it

were followed through to its logical conclusion we would have automobiles that are better and which would at the same time bear the relationship to some of our present designs that is best expressed by saying that they give equal comfort with higher efficiency and economy.

War has a purifying influence. It turns the searchlight upon us in such a way that our errors are shown up more clearly than they are in peace times. If we have a national failing in that we are extravagant, let us search out the influence of this extravagance in our best means of personal transportation, the automobile, and bring it up to the level it should be brought to.

It does not seem right, in the face of the struggle we have on hand, to see a little woman weighing perhaps 100 lb. driving alone and unaccompanied a huge touring car weighing more than 2 tons. This is bad economy, it is wasting fuel, rubber, oil, metal, and it is not what we want in any times, much less now. This is only an exaggerated case of what we see every day, but people are not going to keep up buying cars that are as far removed from their everyday needs as this. The car has got to be of the correct size for the purposes to which it is to be put.

Buying Transportation

It will not take long for the sales departments with their fingers on the pulse of the buying public to discover the definite effects of the national wave of economy on car buyers. When the sales department discovers this, it is but a step to the engineering room, and it will not surprise the wide-awake engineer when he is called before the board of directors and asked to produce a car which will wring the last ounce of performance out of every drop of fuel, which will travel the last available mile on its tires, which will have all the get-away and flexibility possible with plenty of room for the occupants, but no wasted wheelbase, no wasted engine displacement and with all the excess comfort and style that the buyer purchases, without having the extra money go into dead weight which has to be carried around to no purpose.

Standardize War Truck Repair Work

Every Repair Job to Be Done by Manual—Even Buildings to Be Standardized

WASHINGTON, D. C., Dec. 29—In line with the general plan for standardization pursued by the transportation division of the Quartermaster Corps under direction of General Chauncey B. Baker comes the new plan of standardization of repair base units for service at home and abroad, by means of which there will be standardized repair shop buildings, standardized corps of mechanics, standardized systems for repair and standardized repair equipment.

What Investigation Revealed

Following beginning of production the B heavy-duty war trucks and completion of designs of the A and AA sizes, the Military Truck Production Board started on its work for the maintenance of the trucks in France. George C. Randles, in charge of the manufacturing equipment, together with James F. Borquin, head of the production work, made a thorough investigation of truck repair on the Mexican border, learning the achievements and the errors of the past. They found some shops excellent, others not so good, with the chief problem that of the inefficient soldier mechanic, soldier foreman and soldier superintendent, who were found among the many soldier mechanics, foremen and superintendents at work.

Many repair jobs were found to be wrongly handled because of ignorance, others because of different opinions between mechanics, and still others because of inferior machinery and tools. The result was the decision to standardize insofar as possible.

The repair base units have been planned on standardized lines. Each average building will have 230,000 sq. ft. of floor space. All buildings will be exactly alike with stock rooms, tool rooms and racks the same in each. And the general plans for these buildings are so arranged that in event the building should be made larger or smaller the change in the plans can be made within a very few minutes by adding or taking away the number of bays required, without affecting the efficiency of the plant. These plans also include consideration of light, heat, power, etc., which can be increased or decreased at will along similar lines.

The value of this plan lies in the fact that where workers are taken from one plant to another they can at once enter upon their duties without strangeness, knowing where to find stock, accustomed to the tool racks, used to certain methods which can be pursued equally well in the new shop. For example, the Quartermaster Corps is now building a large mechanical repair shop unit at Baltimore, where 2000 mechanics will work on the trucks coming overland from the factories to the seaboard. Construction of this plant and also of the warehouse which will adjoin it and serve as a commissary to the trucks began last week. Completion is expected in 90 days. If after these mechanics have been thoroughly trained at the truck repair work in this shop the War Department decides to send them to France, it will be a simple matter. The men can be transferred readily, and when they enter the shop in France will find the stock rooms, tools, machinery, light, power laboratories, everything exactly as in Baltimore.

Manual to Guide Mechanics

The next standardizing step is that of rebuilding and repairing. There are certain fundamental principles of mechanics for this work, and the plan provides a system that insures that each mechanic will follow the proper methods. A book to be known as the Shop Manual is now being compiled which so definitely lays down the rules to be followed for repairs that it will be impossible for a mechanic or a foreman to use his own judgment. The plan insures uniform work at every base and on every job. Instead of depending upon the foreman to say, for example, that a cylinder is not in need of regrinding, the workers will turn to their manual, which strictly defines the cylinders that are out of round or tapered beyond good practice and definitely specifies the regrinding and the oversize, which is also standardized. This also applies to the crankshaft, where if the pins are egg shaped all must be ground to a certain undersize to clean up properly. In this way every job must be done thoroughly,

and there will be no opportunity for men to use individual judgment or to experiment at a time when experiment may mean a penalty of lives. The shop manual is now being compiled and will be completed in the near future.

All tools and machines are being standardized in so far as this is consistently possible with good judgment. All machine tools, for example, are standard belt driven because belt-driven machine tools are easier to secure than motor driven, because there is always possible the conflict of alternating and direct currents and of different voltages in the use of the motor driven, and because with a line-shaft drive if emergency demanded a gasoline engine could be attached and used efficiently.

All mechanics' tool kits will be standardized, each mechanic of the different classes carrying identical tools, which will be subjected once a week to military inspection, much the same as with the arms of the infantry soldier. This inspection will apply particularly to the finer tools, which have to be almost perfect to insure efficient results.

Thus between the standardized shops, machines, tools and repair instructions of the shop manual, every truck entering the shop for repair will proceed through exactly the same movements from entrance to exit that every other truck in its class will pass.

The standardization extends also to the mobile repair units, the trucks carrying small repair shops aboard for making field repairs. These will carry standardized repair tools and machinery, and plans are now being made to perfect every detail of the repair mechanism to the highest degree. For example, a large drilling machine in the original equipment has been eliminated and a small drilling attachment substituted that is more efficient, and the original lathes standing on two legs, which were unable to withstand the shocks over the roads and usually resulted in lathes out of line, have been changed so they rest on a center pedestal over a cabinet, insuring firmness of position.

The numerous results of this system are quickly apparent. They include:

The making of good mechanics, versed in the fundamentals of efficient repair work.

The elimination of the "hammer and cold chisel" sort of repair men, well known to the average motorist.

The training of men mechanically and with a discipline that will make them most valuable in civil life.

The elimination of all chance for experiments. Familiarity with shops and systems instead of strangeness with every transfer.

A repair system that insures maximum efficiency in the maintenance of the quartermaster trucks in France.

The average base repair unit is expected to hold 1163 men under the direction of a major.

The plan of organization of this general scheme of maintenance includes:

Supervision of standardization by George E. Nandles, whose duties include provision for standardizing all buildings, power plants, stock rooms, warehouses, lighting, heating, plant transportation, manufacturing equipment and methods, together with various details connected with modern plants and manufacturing practices for the work to be performed and the compiling of all data necessary. He is being assisted by:

F. A. Barnes, industrial engineer of Cleveland, Ohio, whose duties include building design, building construction, cranes, power plants, water, heating, lighting and sewage.

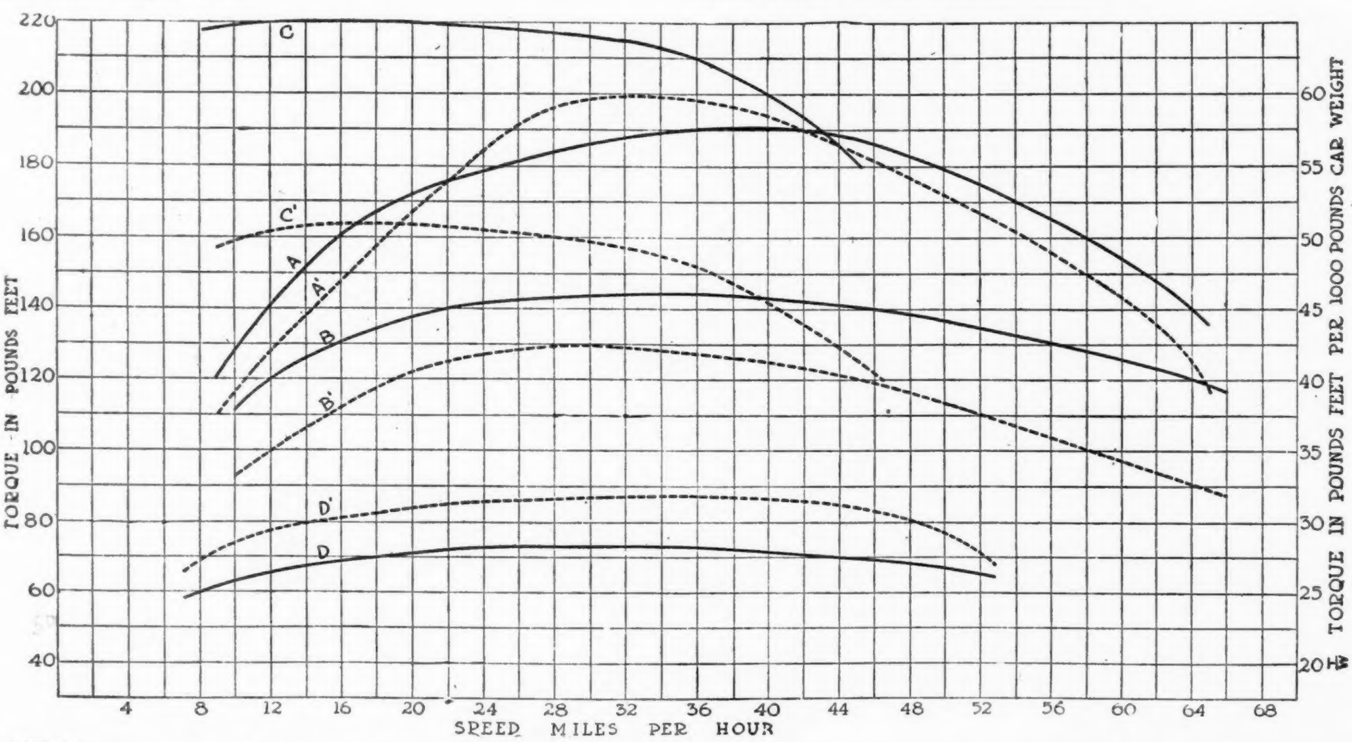
D. C. Selheimer, production engineer, formerly with the Packard Motor Car Co. and the Hal Motor Car Co., who is working out the details of all manufacturing equipment, such as machine tools, small tools, mechanics' tools, shop transportation, arrangement of departments and manufacturing layout details. He will be assisted by Lieutenant Rogers.

Major North, who will provide complete plans and specifications for recommendations for procurement of various items; follow up purchases and maintain purchasing records.

Lieutenant Lord, who will work out the shop manual of standardized operations, together with parts lists and instruction books of the Class AA, A and B trucks.

B. H. Eaton, who is arranging details of plant systems, including tool cribs, warehouses, receiving, stock room and shipping.

Major Parramore, an army officer, who will act in a consulting capacity. Major Parramore has seen active truck repair service on the Mexican border.



CURVES IN WHICH SOLID LINES SHOW ACTUAL ENGINE TORQUE AT DEFINITE CAR SPEEDS AND DOTTED LINES INDICATE TORQUE IN RELATION TO WEIGHT AT THE SAME SPEEDS

A=Six-cylinder, 3½ x 5, geared 4.46 to 1, 35-in. wheels; weight, 3214 lb. A'=Car A plotted against T/W per m.p.h.
B=Eight-cylinder, 2⅞x4¾, geared 4.05 to 1, 34-in. wheels; weight, 3375 lb. B'=Car B plotted against T/W per m.p.h
C=Twelve-cylinder, 3x5, geared 4.36 to 1, 35-in. wheels; weight, 4375 lb. C'=Car C plotted against T/W per m.p.h.
D=Four-cylinder, 3x4¼, geared 4.70 to 1, 30-in. wheels; weight, 2200 lb. D'=Car D plotted against T/W per m.p.h.
T=Torque in foot-pounds; W=Car weight/1,000; M.P.H.=Miles per hour

1918 Engineering Trends

¶ War Has Restricted Engineering Development in Passenger Automobiles, But Major Trends Show Continued Progress.

¶ Full Pressure Oiling Systems, Spiral Bevel Rear Axle, Unit Motor and Gearbox Design, Disk Clutches, Single Ignition, Helical Drive for Motor Parts, and Overhead Valve Engines Show Increasing Percentages in Use.

¶ Engine Revolutions Per Mile Are Lowered and Tire Sizes Slightly Increased—Expected Weight Reduction Has Not Materialized.

By A. Ludlow Clayden

ON another page in this issue is a chart which shows the rapid rise into favor of the spiral bevel—how it arose in January, 1915, shot upward, became the standard type almost. The curve starts gently, rushes up rapidly and then tails off gradually.

With a different notation the selfsame curve might very well be used to represent engineering activity in the passenger automobile field for the same period.

The year 1917 has been one of practically no development. War has stopped experiment in many directions, and the realization of war has not been with us long enough to have started it in other lines. The immediate effect of war is a large increase in average price, but this is purely temporary. It does, however, serve to drive home the fact that the sort of cars building to-day are rendered more costly by difficult conditions; and in similar measure the cost of operation has been raised in common with nearly all other living costs. The automobile engineer's next task is to fight and conquer cost of operation—to produce cars which will do essentially the same work for the old price instead of the new one.

None the less the trends shown in the analysis of all the chassis listed in January, 1918, will in the future come to be one of the most interesting series ever prepared. The present year must be a turning point in many ways; it cannot fail to mark a point of change in automobiles as in so many other things.

Meaning of Average

Before proceeding to analyze the trends it is necessary to make the annual explanation of the fact that by considering all the chassis listed without regard to the output of each maker the averages deduced are averages of engineering opinion; and it is this which such analyses seek to discover. An analysis by production would throw into absurd prominence the features of a very few cars which happen to be very cheap and to be made in huge amounts. That which the small producer is doing to-day the big producer will generally be found to be doing to-morrow.

Average Price $1,822

From $1,687 to $1,822 the average price of the American made five-passenger touring car has risen a total of $135 in 1917. The bottom price was touched two years ago, when the average was $1,600. The present price is $96 less than the average of 3 years ago. Of course it is the rising cost of everything which has been the main factor in provoking the rise in price this year, but it is true that the tendency toward better quality of workmanship noted last year has continued. If materials and labor had not risen in price since Jan. 1, 1917, it is probable that the average price of the American car would still have shown an increase. The low-water mark of January, 1916, was uneconomically low; it was a low price caused partly by fear of decreasing demand.

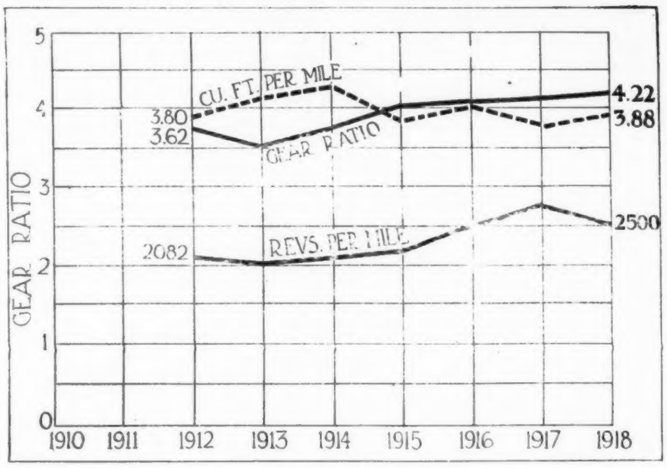
Wheelbases Are Longer

There have been some mechanical changes which stand out prominently, as, for example, the increase in average wheelbase from 113¼ to 120¾ in. This takes us back to the average of a little more than a year ago. Engine size has also enlarged, the average piston displacement now being 269 cu. in., as against 222 last year.

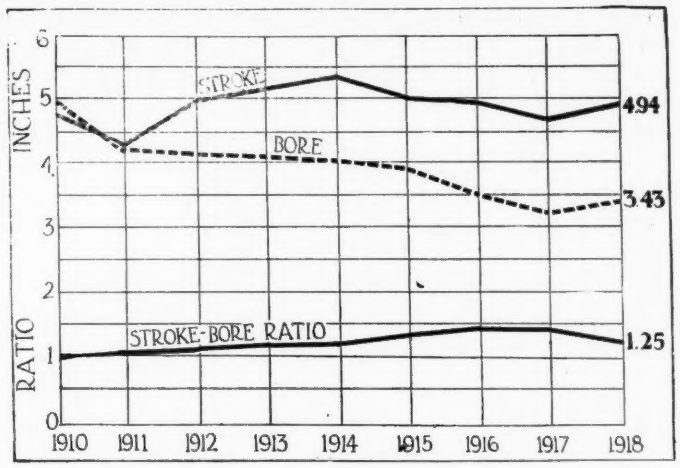
It was commented last year that lowness in gear ratio had probably been reached, and this prophecy is upheld by the present figures, which show that the revolutions per mile now average 2500 instead of 2726. This is owing to an increase in average tire size from 31 to 34 in., for there has been an actual decrease in gearing ratio, last year's average being 4.15 to 1 and this year's 4.22.

Among all the other averages tabulated there are few showing more than the very slightest alteration. Most of the curves illustrated follow their

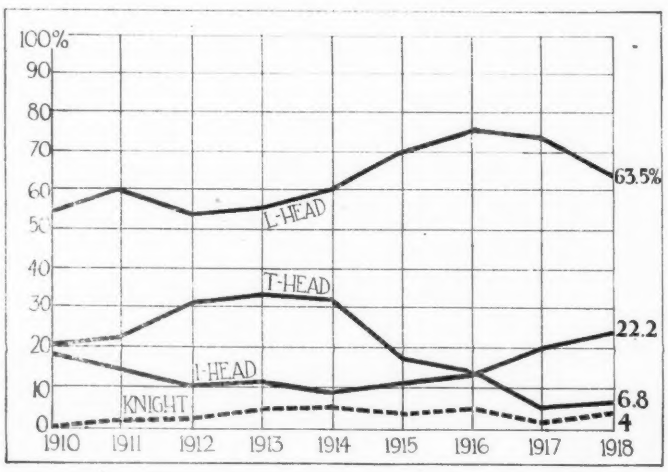
1918 Automobile Engineering Tendencies



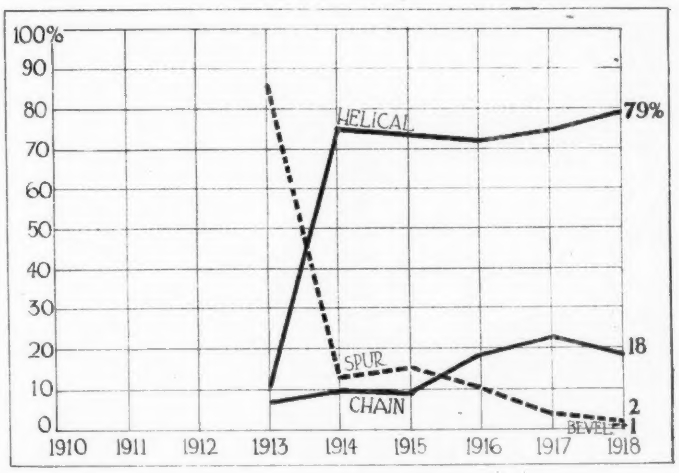
Compared with last year the crankshaft revolutions per mile are 2500, whereas a year ago they were 2726. Average tire sizes have increased and the rear axle gear ratio which one year ago averaged 4.15 to 1 to-day averages 4.22 to 1. The reduction in car weight anticipated a year ago has not materialized largely due to war conditions greatly restricting engineering changes



This year, 1918, models show an increase in engine size, the average piston displacement being 269 cu. in. instead of 222. For three years previous to 1918, the engine displacement has been constantly growing less until the upward tendency of this year. The bore and stroke ratio has dropped from 1.36 last year to 1.25 at present; the average cylinder size to-day is 3½ by 5 in.



The increase of the valve-in-the-head engine which has been gaining steadily since 1914 continues, the net gain this year being 2.2 per cent, which is made at the expense of the L-head, which for 2 years has been losing in the percentage list. The T-head has held its own and the Knight type has gained



In the drive of motor accessories, three positive trends which gave indications one year ago are continued. Helical drive after its phenomenal use of 5 years ago continues to gain, whereas chain and spur gear drives continue the downward curve which was in evidence last year

natural tendency; as, for example, the rise in the percentage of overhead valve engines, and the increase in popularity of the disk clutch.

Cylindricity remains much the same, rather more sixes; 51.7 as against 47 per cent and fewer eights and twelves in proportion. There are six fewer makers and twelve fewer chassis listed in the specifications.

Nineteen seventeen has been a year of manufacture rather than of design. It has been a year when a manufacturer's task was to get material and not to improve his machine—a year when engineers have been handicapped as never before. The only changes which really count for anything, which are matters of principle as distinct from body changes or other matters of fashion, are those made to facilitate the burning of heavier fuel. These changes probably mark the beginning of a new era. They probably are the heralds of the time when gasoline will cease to be the motive power of road vehicles. The change is from the purely gas engine to something more allied to the purely oil engine. Instead of merely metering the fuel and mixing it with air, the later engines vaporize the fuel as well, or partially vaporize it. We are within sight of the practical engine which will *start*, as well as *run*, on fuel with no light fraction if necessary; of the time when double the present percentage of crude will be available as an automobile fuel.

Many of the anticipations of a year ago have not been realized, largely owing to the impossibility of doing much development work. Thus the expected general decrease in weight has not come about. Aluminum remains too scarce and expensive and

the high-grade steels required are in the same category. Electric or magnetic drive is another feature much discussed in 1916 and now hung up by war conditions.

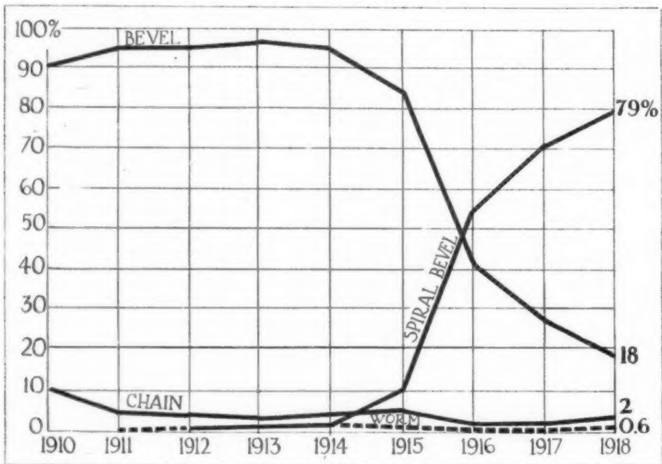
The year of greatest change was 1915. Nineteen sixteen was the year of greatest production; 1917 has been a year of consolidation of the engineering development of 1915 and the engineering experience of 1916. A great many old-fashioned stock parts have vanished. There has been a considerable cleaning up of stock motors in particular. The period of spring experimentation has ended in a triumph for the semi-elliptic, although the cantilever and platform and even the elliptic springs have still their supporters. Argument that any one form has inherent advantages over another has ceased, it being realized that it is possible to get any desired result with any type of spring if sufficient care is taken with the design.

In axles, steering, electrical gear, carbureters and transmissions there have been no changes worth mentioning.

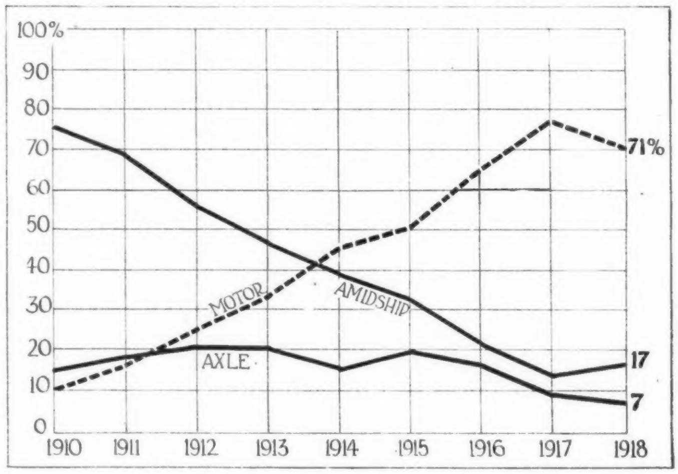
The alleged shortage of materials has failed to materialize in a drop in the use of alloyed steel for chassis parts. The percentage of alloyed steel in the chassis is relatively small, and even though there are detailed alterations in parts to permit of the use of the high-carbon product in some instances, these alterations have not been of enough importance to show up in the tabulations and curves.

Trends in accessory design have not been marked. Perhaps one of the features of the year is the introduction of improved priming devices to aid in overcoming starting difficulties. Accessories which are used as standard fittings such as steering wheels, dash meters and gages have not been materially altered, although their arrangement is such that the devices are more easily seen by the driver.

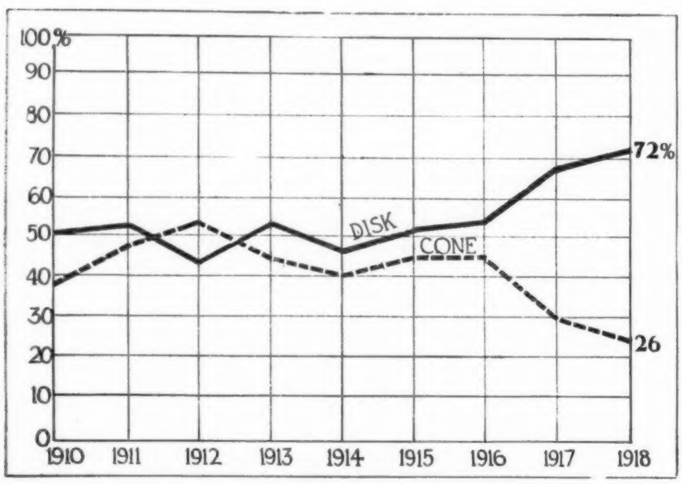
Engineering Trends Shown by Curves



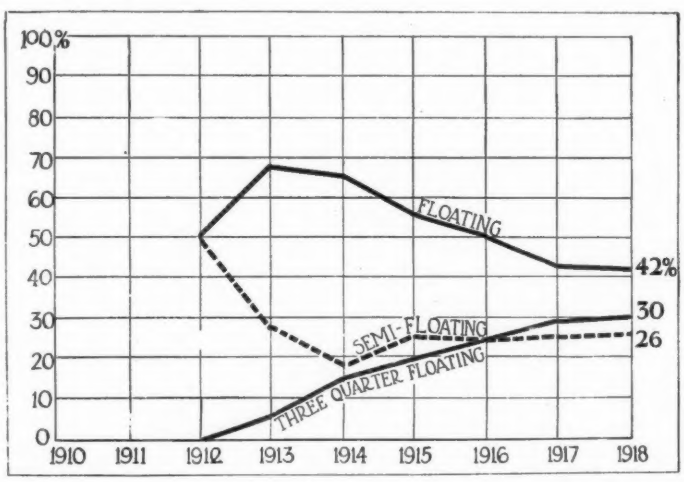
The trend of rear axle design started in 1914 has continued consistently to date, with spiral bevel rising steadily to 70 per cent, bevel losing steadily and now at 18 per cent and worm and chain remaining stationary. The popularity of the spiral bevel is marked



It was in 1914 and 1915 that definite trends in gearset location set in, although the last year has introduced some counter movements, notably the falling off of mounting as a unit with the engine, and a corresponding gain of the amidship location



From 1910 to 1916 the clutch field was quite evenly shared beteween the disk and cone, with the cone leading in 1912, but since 1916 the disk has gained so as to have nearly three times the percentage following the cone has



The definite movement in rear axle design extending over 8 years has been the constant, consistent gain of the three-quarter floating type and the equally steady loss of the floating design; the semi-floating type has held its own

Engine Design for 1918

Cylinder Sizes Slightly Larger Than 1917 — Pressure Lubrication Has Gained — Overhead-Valve Types Increasing — More Counterweighted Crankshafts — Bore-Stroke Ratio Is Lower—3½x5 Average Size

PROBLEMS of heavy gasoline have completely ended the cylinder controversy. Looking backward over the past three years it seems that the eight and twelve have served to bring back the four into higher favor, since despite a decrease in the proportion of fours in the whole list there have been several new high-grade fours put on the market in the last two years. It was predicted by Howard E. Coffin that the eight and twelve would compel the production of *better* sixes; and this has indeed come to pass, for the average engineering quality of the stock six-cylinder engine is far above what it was even a year back.

The Average Cylinder

The nearest to an average for all American passenger cars would be a six-cylinder machine with an engine having dimensions 3½-in. bore by 5-in. stroke. The engine size proportions and variations in dimension with the different numbers of cylinders are rather interesting. Of all the cars listed in the specification tables, eliminating chassis which are duplicates except for wheelbase variation, 34.6 per cent are fours, 51.7 sixes, 10.2 eights and 3.4 twelves. The grand average dimensions are 3.93 by 4.94 in., giving a displacement of 269 cu. in. Splitting the engines up in order of cylinder number gives the results following:

Cyl. Number	Bore	Stroke	P.D.
4	3.6	4.95	221
6	3.46	5.00	282
8	3.13	4.59	282
12	2.87	4.96	386

It is a curious thing that the average size of the six and eight should be the same, and probably this may be taken as meaning that the normal, medium-size car of to-day is best suited by an engine of this size. It is perhaps a little surprising that the fours average so high a displacement. Allowing for the fact that many of the fours have small wheels, this probably indicates that the displacement per mile run differs only a little as between the sixes, eights and fours.

The average engine is larger than it was a year ago; 269 cu. in. as compared with 222; the gear ratio has changed from 4.15 to 4.22, yet the increase in average tire size from 31 to 34 in. has prevented a large increase in the displacement per mile run on high gear. A year ago this averaged 384 cu. ft., and it now comes out 388 cu. ft. This means that ability as measured by displacement per unit of distance has not been increased. Probably there has been a little increase in mean effective pressure, especially among the newer sixes, but this will not have been great. On the whole, therefore, the ability ratio may be said to be unchanged.

There are more overhead valve engines by 2.2 per cent, and fewer L-head motors. Also there is a new type never before listed on stock cars, this being the horizontal valve. This is employed on the new Duesenberg stock engines, and this motor is used on 2.3 per cent of the listed chassis. The listed Knight engine chassis have doubled in proportion, increasing from 2 to 4 per cent.

Thus while the L-head motor remains the commonest type, it is apparently on the wane. Taking the years 1915, 1916 and 1917, the L-head showed 70, 73.3 and 73 per cent, while it has now dropped to 63.5 per cent, and a falling off of 10 per cent in a year of stagnation in design is significant.

There are no more adherents to the multi-valve idea sponsored by Stutz and White, but this is perhaps due to the paucity of new designs. It is a somewhat expensive design and most novelties are in the direction of cheapness rather than increased cost.

Unfortunately figures for the proportion of detachable cylinder heads are not available, since there has without question been a large increase in its use. It is a long time since any new engine has appeared without this feature, and this year has seen Cadillac change over as well as Packard.

Single Ignition Leads

Ignition has followed the natural trend toward single-current source, this being now the battery. Details have been improved in both batteries and breaker mechanisms, so the magneto shows no signs whatever of returning to its original position of universality despite its continued employment on many of the most expensive cars. The weakest points in ignition systems are now the automatic advance, which is developing slowly but surely, and the material available for contact points. Both platinum and tungsten are so scarce and so much in demand for war purposes that every magneto and distributor maker has had his troubles in maintaining the supply of contact material. The established manufacturers have been able to keep up the quality fairly well, but with the return of peace a

big increase in the life of contacts will be observed.

Engine balancing has been a continued study during 1917, and the day of the counterweighted crankshaft has arrived. There is a considerable difference of opinion as to how far it is really necessary to go in balancing, this subject being as yet only partly understood. The matter is discussed fully in another part of this issue. Still the 1918 Show does mark the emergence of the counterweighted crankshaft from the peculiarity stage into the realm of conventionality.

Pressure Oiling Gains

In lubrication, circulating splash or combined splash and pressure systems have gained a great deal. In percentage the full pressure system has fallen off a trifle from 30 to 28 per cent, but this is due to decrease in models rather than to decrease in the number of believers in the system. In the tabulation the old style of separating splash-pressure and circulating splash (trough system) has been abandoned because of the many degrees of variation possible. Some engines have practically a full-pressure system plus dip troughs for the connecting-rods, and some rely mainly on the troughs but use separate feeds to the main bearings. The real distinction comes now between those engines which have the troughs as an accessory or as the main lubrication source and those which rely entirely on pressure and have no dip for the connecting-rods. Thus the two percentages given under "splash" and "splash-pressure" last year should be added together in comparing them with the total of 71.6 per cent for this year, and we then see an increase for this system of 1.6 per cent. There is only one car listed with plain splash lubrication, that is dip for the connecting-rods without troughs.

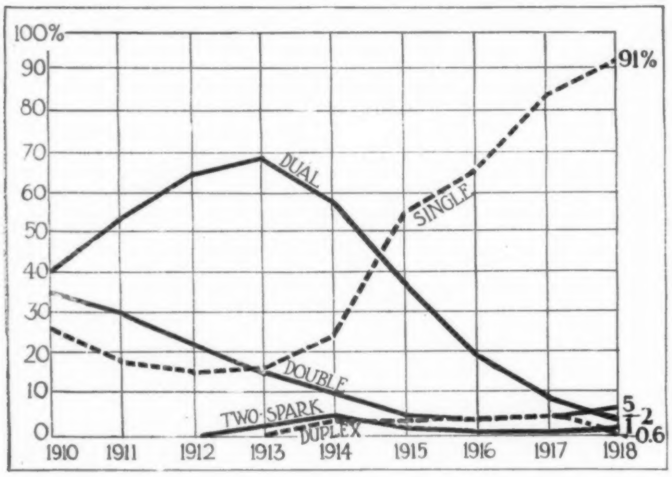
In pressure systems there are many variations. Last year it was anticipated that the 1918 tabulations would show a strong trend toward controls which would proportion the oil supply to the engine bearing loads. This has not come to pass. Most of the pressure systems are low-pressure systems; that is to say the maximum shown in the gage with warm oil seldom exceeds 10 lb. per square inch.

Probably the difference between splash-pressure systems and pure pressure ones has been exaggerated. The former is only different in that oil is supplied to the crankpins externally instead of internally. The pressure shown on the gage in a full-pressure system is often higher than that prevailing actually between the crankpin and its connecting-rod bush; while oil supplied externally to a connecting-rod is given some pressure by the relative reactions within the bearings.

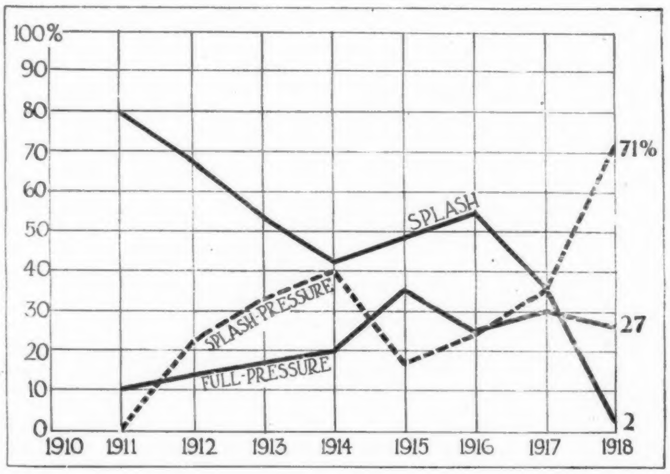
Speaking broadly, the majority of manufacturers whose prices permit the drilling of the crankshaft prefer to supply the pins in this way, and most of those who prefer to use dip troughs do so because they give almost the same if not quite the same results when in combination with direct feeds to the main bearings. The leading advantage of the pressure system is that it gets the oil to the bearing surfaces quicker in cold weather, and most of the wear on bearings takes place during the first five minutes of running.

Probably the most satisfactory feature of engine improvement is in the line of better volumetric efficiency. Engines are giving bettre torque curves and higher ultimate performance, simply because they are being filled better on the intake stroke. This is true in spite of the fact that the intake passages are heated to a higher temperature now than ever before, thus, although there is a normal expansion of the gases due to the higher temperature of the intake, this expansion is more than compensated for by improvements in cam design and by carbureter manipulation resulting in higher velocities of the intake gases.

The so-called hot spot intake does not do anything towards making engines easier to start. It has a marked influence, however, in shortening the period of warming up, and this is highly gratifying to the user of present day fuel.



Ignition movements since 1914 have been generally consistent. Thus single ignition that started gaining in 1912 has risen constantly and is now a 91 per cent factor and dual and double has been consistently losing. The two-speed movement is stationary



Last year the engine lubrication field was almost equally divided, with 35 per cent each for splash and splash pressure and 30 per cent for pressure. In the last 12 months splash pressure has doubled its following and the other two divisions have lost, splash being almost eliminated

1918 Chassis Design Features

Semi-Elliptic Springs Established—Wheelbase Raised from 113 to 120.7 Inches—Frame Changes—No Weight Reduction

APART from changes in engine design extremely little has been done this past year. Chassis were greatly cleaned up in 1915 and 1916; there is not room for a great deal more change without introducing new principles. The gearsets produced by the stock-parts makers are nearly all identical with previous designs, the axles are likewise unaltered and there are no novelties in steering gears worth mentioning. Even spring design has been stagnant.

The three-speed transmission integral with the engine as a unit is found on three-quarters of the listed cars; the relative proportions of full and semi-floating axles remain about the same; there is nothing new in frames or springs. The spiral bevel is the predominant form of final drive, having increased from 70 to 79.4 per cent. Wheels are larger, being now shod on the average with 34 by 4-in. tires instead of 31 by 4-in., a return to the conditions of January, 1915, which is a little surprising in the light of the popularity of the 32 by 4-in. tire. There are more wire wheels, these being now either standard or optional without extra charge on 27.8 per cent, leaving 72.2 per cent on which only wood wheels are fitted. This is mainly a manufacturing matter, and if progress is normal during 1918 there will be more wire wheels to list in January of next year.

Semi-Elliptic Most Popular

In springs 44.4 per cent of the listed chassis have semi-elliptic, 29.6 cantilever and 17 per cent three-quarter, the balance being divided between platform, transverse and special systems. Two cars, the Jackson and the Franklin, remain the only users of the elliptic system. Cadillac, Dorris and Peerless are the only cars using platform springs, Packard having changed to semi-elliptic. Hotchkiss drive is used on 53 per cent of American chassis to-day.

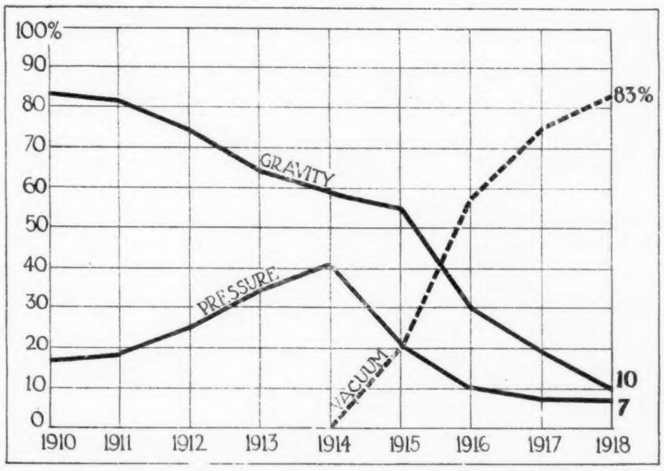
Increase in wheelbase to an average of 120.7 is unexpected, since last year it had shrunk to 113. The present figure is almost the same as that prevailing the year before last. It means that the average body on 1918 cars will have perceptibly more leg room. Of course a slight increase in wheelbase is to be expected at a time when we also see an increase in six-cylinder models, but a couple of extra cylinders on 5 per cent of American chassis is not enough to provoke more than a fraction of an inch on wheelbase average.

A change which does not show on tabulations, but which is quite important is that toward deeper frame sections and stiffer frame construction. This goes hand in hand with the tendency to use more leaves in springs, in that its sole purpose is to make for better riding. It is hardly possible to use an 8-in. frame section except when entirely redesigning a chassis, so in this quiet year there have been few extreme cases of deep frames. A good many manufacturers have added a half-inch, or some similar amount which is insufficient to necessitate completely new brackets all over, a new motor support, and so on. Still it is certain that the next redesigning period, which will most probably be the year after peace is declared, will see automobile frame construction greatly changed. Such frames as the Marmon and the Premier are typical of the construction of the future.

Weight Reduction Halted

Weight-saving in chassis parts which had begun a year ago is halted by the present need for using only medium-grade materials wherever possible. The amount of interest which the automobile engineers are now taking in aviation will certainly provide them with plenty of ideas for the future, and many have plans laid for a much lighter after-the-war car.

Every year for many years, in reviewing the annual progress of either America or Europe, it has been necessary to remark that steering and brake design are on the average poor. The *best* in brakes and steering is much higher above the *average* than is the best of most other features. Steering gear and the brakes remain the poorest parts. Nothing has been done in 1917 which can be regarded as a general improvement. It is a welcome feature, however, that accessibility in the front compartment has been noticeably improved because of the almost universal increase in leg room. This has been as much as 2 in. on a number of cars.



For 4 years the use of vacuum gasoline feed has increased steadily, and gravity and pressure feed have decreased just as steadily. Present curves would indicate a further continuance of these movements

Modern Manifolds

Hot Spot, First Effect of Scientific Study, Still Semi-Experimental—Too Much Heat Injurious—Four Typical Examples

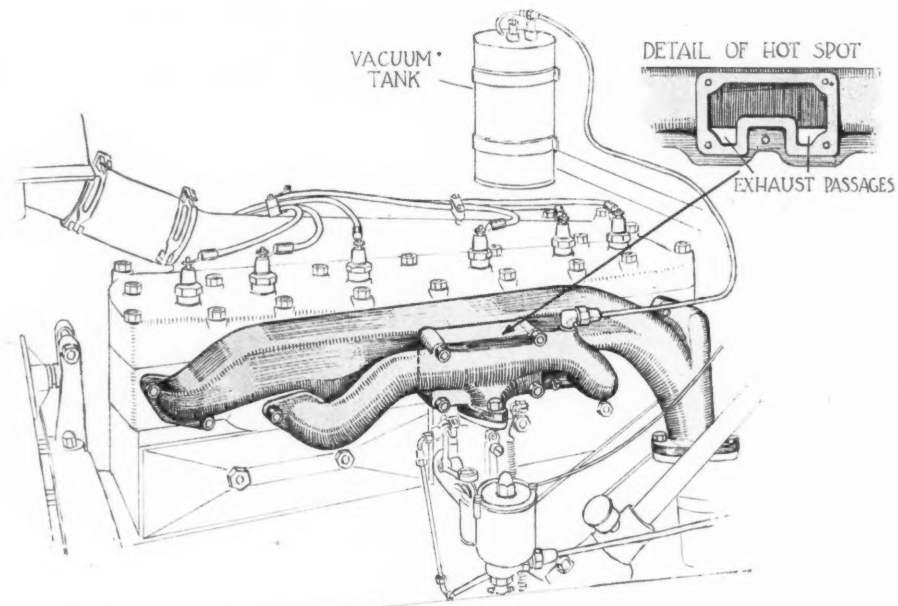
ONE of the details which have been given the closest attention during the past year has been the intake manifold and the methods used for preheating it. It has been universally conceded that owing to the high boiling point of the present-day fuel it is necessary to apply external heat before proper care can be taken of the fuel. The methods, however, which have been utilized to secure this heat differ in a great many respects.

Owing to the fact that flexibility is one of the main factors demanded of the passenger car, care has to be used in how the heat is applied. It is readily possible to secure an excellent mixture for *constant* throttle conditions, but when the varying throttle conditions met with in passenger car practice are taken into consideration, it is not so simple to secure the flexibility. Preheating the fuel and preheating the intake air before it comes in contact with the fuel are both methods which work out satisfactorily for constant throttle openings. For variable throttle openings, however, it is necessary to heat the intake mixture and also to preheat the air in addition, to some extent, depending upon outside temperature conditions.

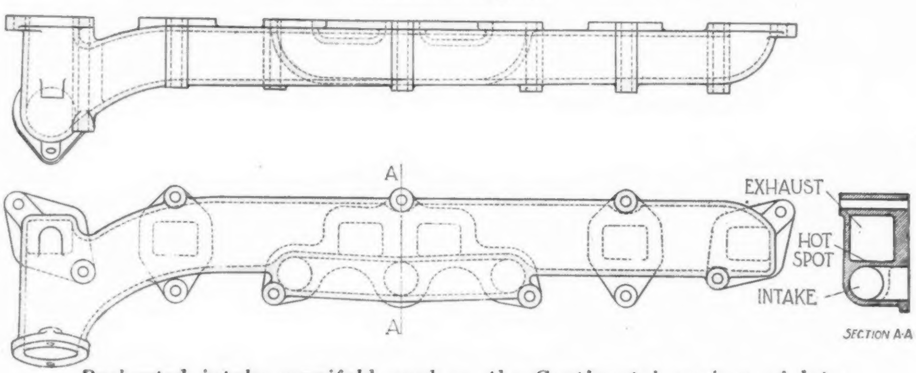
It must be conceded that the hot-spot intake manifold does not completely solve the heavy-fuel problem. There are weak points in its application, although it cannot be denied that it has many good points and it does do the work well, if not at all times in a perfectly satisfactory manner. Where it falls down is in starting.

Another place where it is weak is that when running slowly there is a lack of heat, and when doing heavy work, such as on hills or on sandy roads, there is an excessive heat. It is the starting problem which presents the most serious difficulty at the present time. It is because of the cold starting condition that so much of the fuel works its way past the piston rings and into the crankcase, giving rise to crankcase dilution, where the lubricating oil is so reduced in quality that it becomes a menace instead of a benefit to the engine.

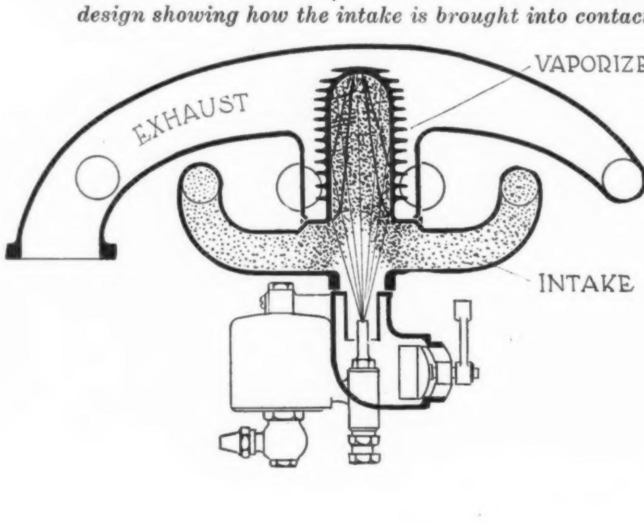
This matter of cold starting is the



Hot spot used on the ram's-horn intake manifold on the latest type of Chalmers engines



Preheated intake manifold used on the Continental engines of late design showing how the intake is brought into contact with the exhaust



A typical hot spot arrangement—section through California heavy fuel vaporizer for Fords

next thing which must have the attention of the designer, and it is surely going to mean that some extra equipment must be added to the car to take care of it as it should be handled.

One company is placing a heat coil in the carbureter float bowl, and other companies are experimenting with the use of a heated coil at other points of the intake system. This may be a solution to the cold starting problem. If it is not, it is at any rate a long step in the right direction.

Once the engine is running, there is no doubt but what under normal conditions the hot spot provides the final step necessary in completing vaporization of the fuel. The unvaporized globules of non-volatile fuels which impinge against the hot spot are immediately transformed into vapor and the loss of volumetric efficiency is not great; in fact, a study of the torque curves of the engines using hot spots shows that there is an improvement in torque in a great many instances, due to the use of the hot intake.

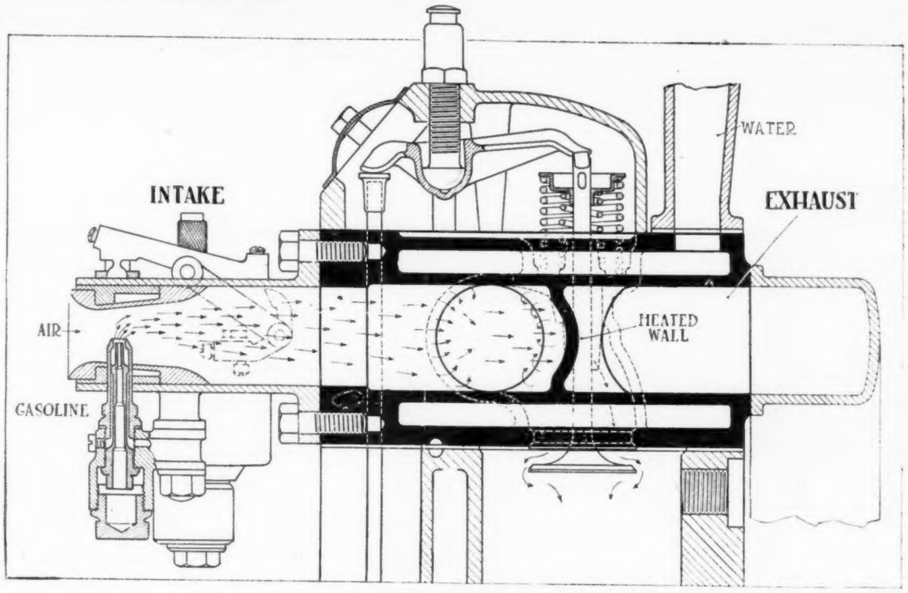
The opinion that the hot-spot intake is the best way of handling the situation is not unanimous. Some engineers raise the question as to whether it would not be better to have a much larger water jacket on the carbureter and intake manifold in handling the present-day gasoline. It is claimed that the water heats up more readily, it keeps hot during short stops, and never heats the mixture to excess. Furthermore, it is claimed that it is easily regulated for summer and winter running, and it appears to give very satisfactory results. Of course it will not give sufficient heat to satisfactorily use kerosene.

Air Must Be Preheated

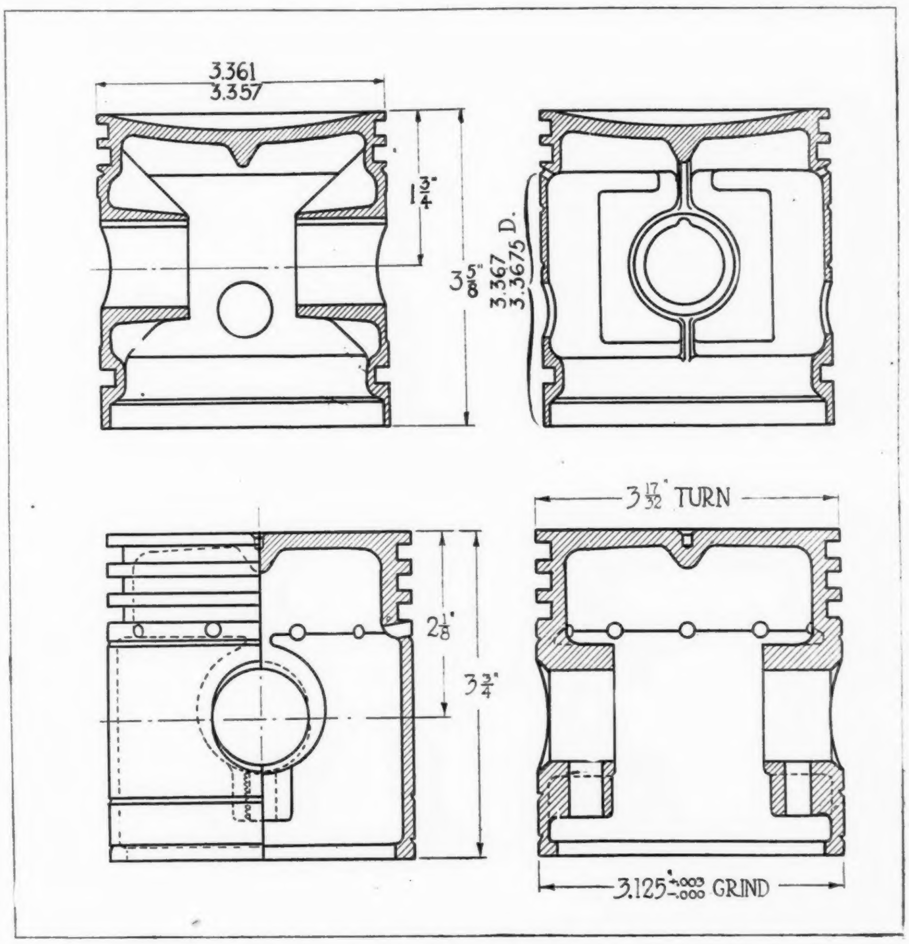
Even with the integral intake and exhaust, where the intake is exposed for some distance of its length to the direct heat of the exhaust manifold, it is necessary to preheat the air to some extent. The amount that the air is preheated, however, should be varied for summer and winter conditions. The system used on the Model R Hupmobile may be cited as an example of where the principle is applied, as there is a summer and a winter position for controlling the pre-heating of the intake air.

Another system which may be cited as typical is that employed on the Hudson carbureter, where, in the latest model, no hot air horn or stove is used at all. Owing to the employment of the shutter on the radiator, the space beneath the bonnet becomes practically a closed room, and it is heated in accordance with the necessity of the case, depending upon the temperature of the external air. The colder it is outside the more the shutters are closed, and, conversely, the warmer it is the more the shutters are open.

Summing up the matter of hot spots, it appears that they offer as good a means as we have available at the present time for handling a difficult fuel situation. Under average running conditions it provides a good, clean, dry mixture without sacrifice of a material amount of volumetric efficiency. Its weak points are the conditions of starting and the unusual conditions of very slow running in cold weather and pulling through heavy roads in hot weather.



Section through Brush manifold showing how gasified fuel enters intake gallery while liquid particles strike heated wall where they are evaporated



Above—Aluminum piston used in the Model 88-8 Overland car. Below—Section through piston of Continental engine used by the Willys-Overland Co.

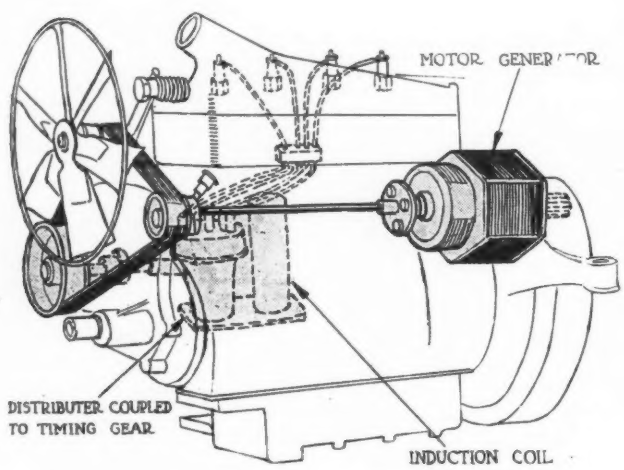
Variety in Auxiliary Drives

Disposal of Engine Accessories Far from Standardized—Different Schemes Have Individual Advantages—Trend Keeps Units High Placed

THE layout of the auxiliary drives of an automobile engine is of supreme importance in securing the proper performance of these parts. In a great many instances the satisfactory performance of a unit depends entirely on the method of attaching it to the engine and to the method of drive, as well as to location. There are a few fundamental facts which are well realized and which are closely adhered to in up-to-date practice. Probably the first consideration is that the drives be as compact as possible, and wherever it is at all feasible one drive should take care of two or three units. This has been growing practice and is a noticeable element in securing lightness of the powerplant. The combinations which have been worked out show a great amount of ingenuity in this respect.

For example, Oldsmobile and Nash might be cited as typical, in that the belt which operates the fan also operates the generator. On the Oldsmobile this drive passes on to the distributor, while in the Nash a separate distributor drive is used in the center of the engine, operated from the camshaft.

This practice of combining drives is one which could be carried out much further than it is. Where individual drives are taken for each of the auxiliary parts, a much greater amount of power than necessary is consumed, and there is sure to be a tendency toward noise, because there are so many more parts in which quietness must be maintained.



Triangular belt drive with motor generator used on Maxwell

Short Plug Leads

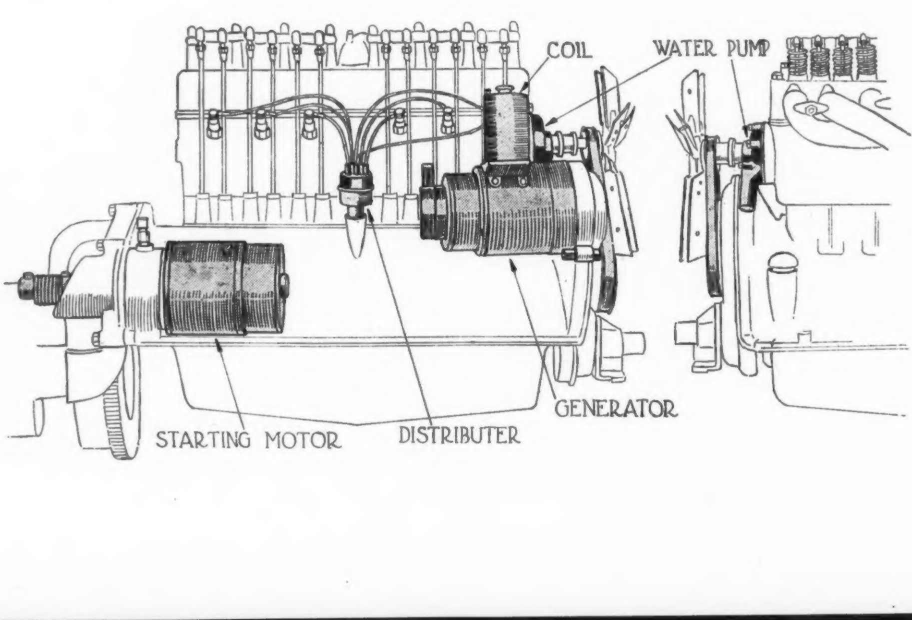
Another feature which is of considerable importance is that the distributor be placed in close proximity to the spark plugs. The amount of current which can leak from the spark plug leads is remarkable, and with the high tension current a small leakage will materially cut down the heat of the spark and reduce the speed of ignition, lowering the rate of flame propagation, and thus reducing the mean effective pressure.

With this in mind it has been practice on the part of some designers to extend the distributor shaft so as to bring the distributor close to the spark plugs. The Hupmobile is a good example, the vertical shaft being extended upwards to bring the distributor above the top of the engine, thus giving comparatively short leads. It is also necessary for the same reason that the coil be located quite close to the distributor, as leakage between the coil and the distributor is just as harmful as it is between the distributor and the plugs.

The tendency towards separating the starting motor and the generator is growing, but it is by no means universal. A very compact unit is used on the Dodge car, and a balanced drive is secured by placing the starter-generator on one side of the engine, with the water pump and distributor on the other. As shown in the sketch herewith, the distributor mounting on the Dodge is solid and at the same time affords a support for the coil.

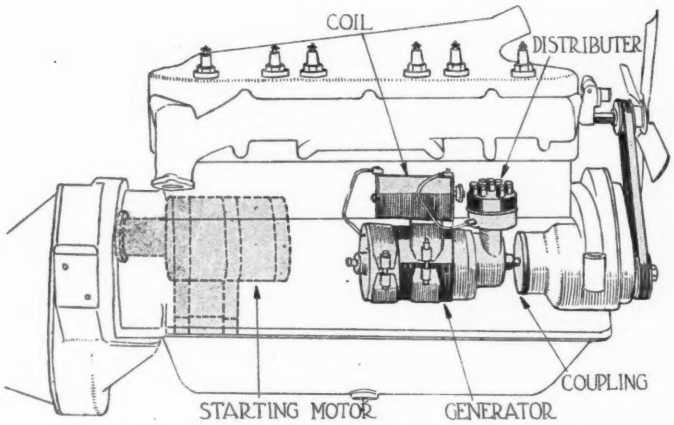
Balance the Drive

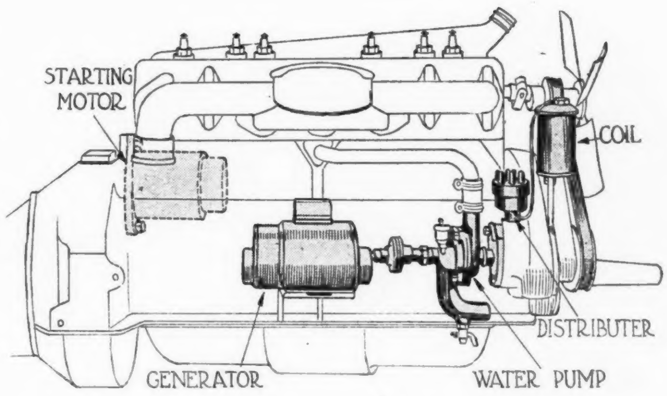
Where more than one drive is necessary, general practice appears to be in favor of establishing balance as far as possible by putting the units to be driven on opposite sides of the engine. This balancing scheme can be car-



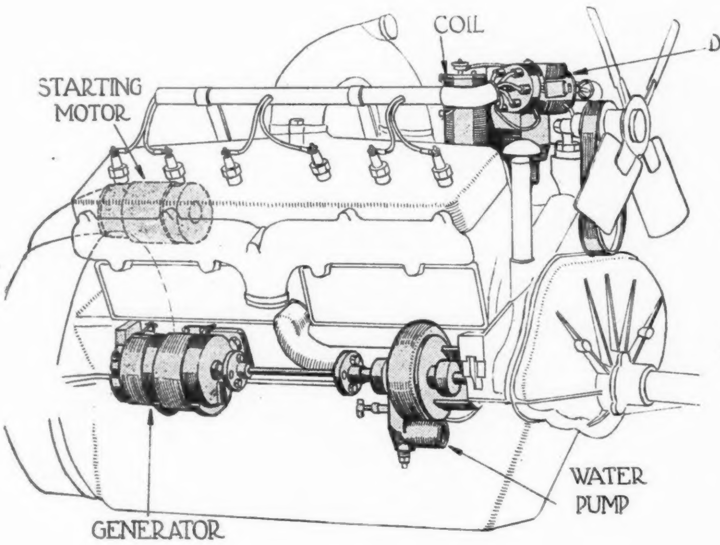
On the Oakland car the water pump is driven by the fan belt, with the distributor drive taken from the camshaft at the center of the engine

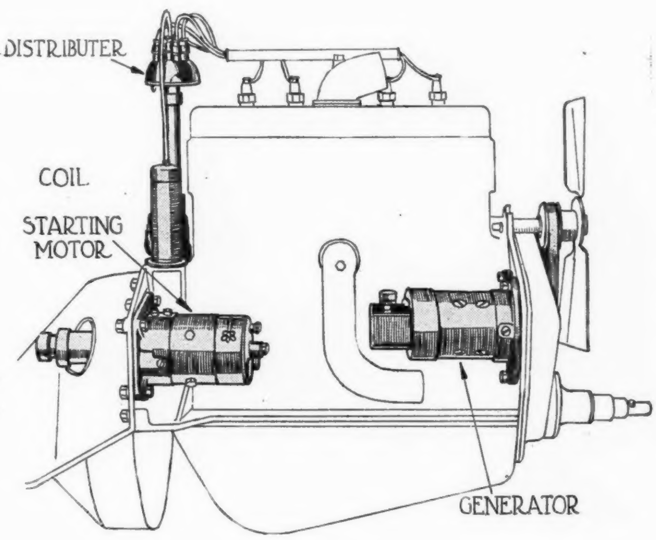
Examples of Different Layouts



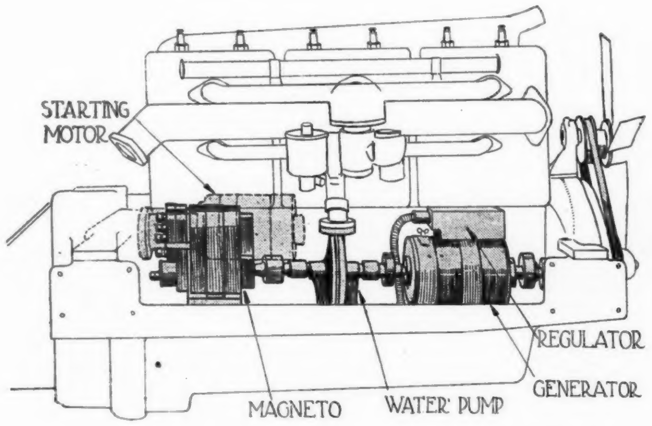


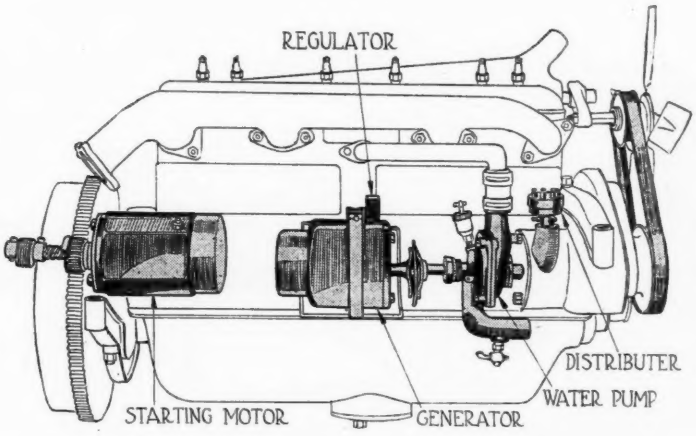
Left—Generator, water pump and magneto driven from same shaft on Winton. Right—Layout used on Overland Model 85-6. Note location of distributor



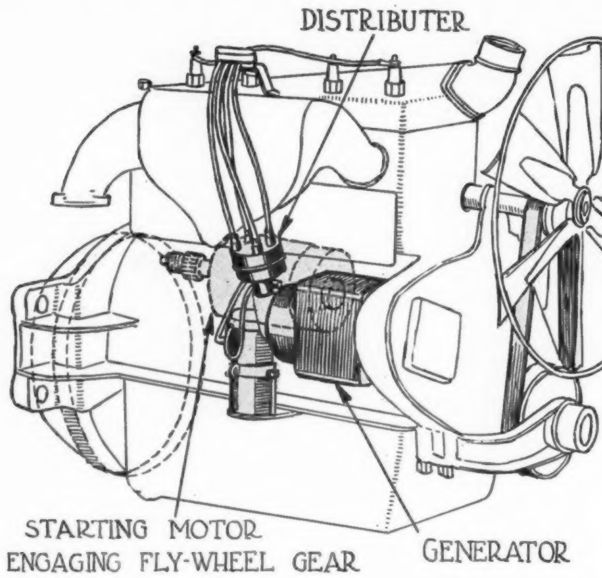


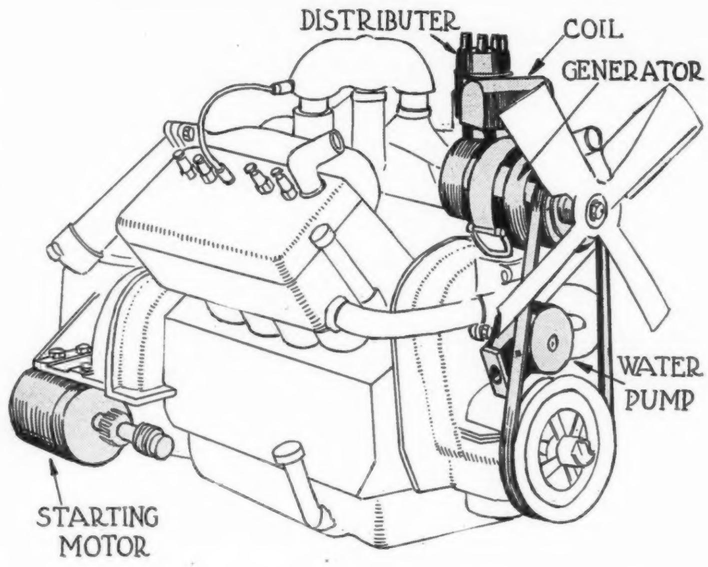
Left—National Twelve layout showing center line starting motor mounted in the V. Right—Hupmobile bolts the starting motor and generator by means of the flanges against the bell housing and timing gear case with an extra long distributor shaft



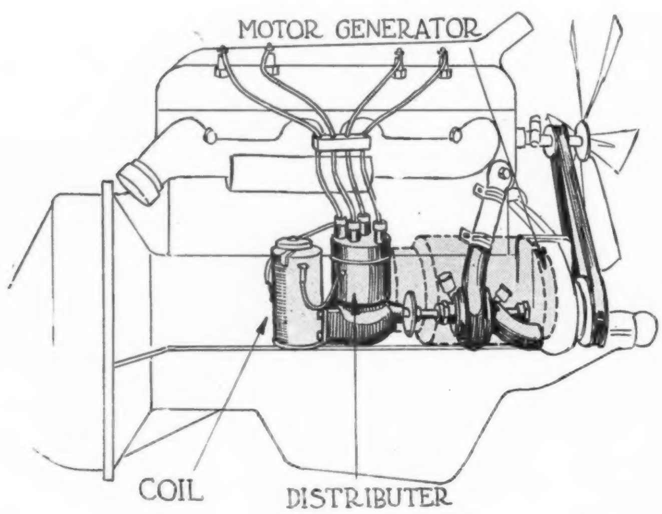


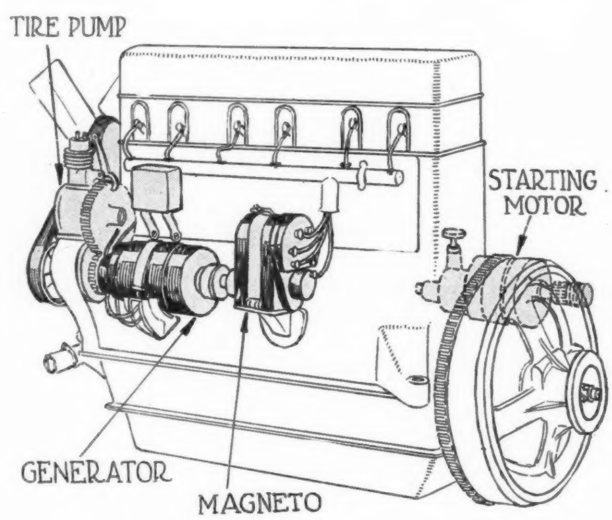
Left—On the Liberty the coil and condenser, as well as the distributor, are mounted with the generator, the moving parts being driven off the same shaft. This is a thermo-syphon engine. The entire unit can be removed by taking out the coupling. Right—On the Paige 55 the distributor, water pump and generator are driven off the same shaft



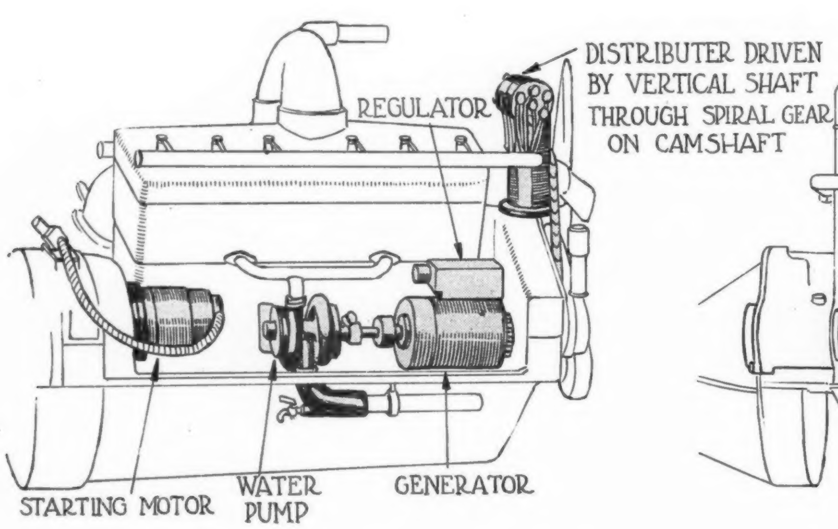


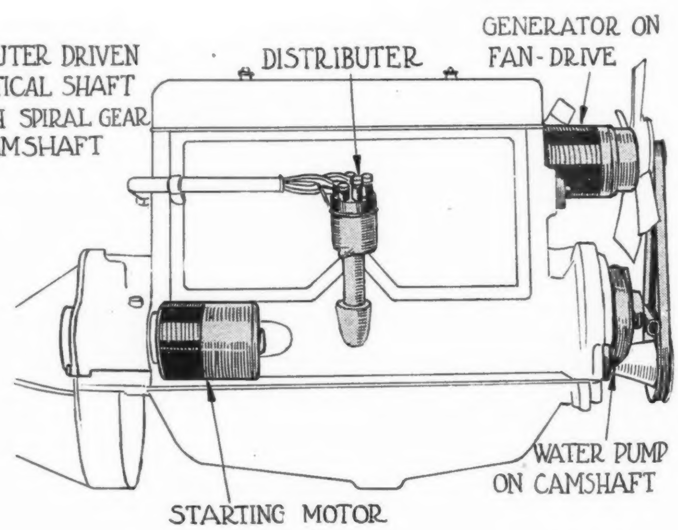
Left—A compact generating-distributor unit as used on the Case 40. Right—Oldsmobile mounts the generator on the fan shaft, with the water pump also on the timing gear housing



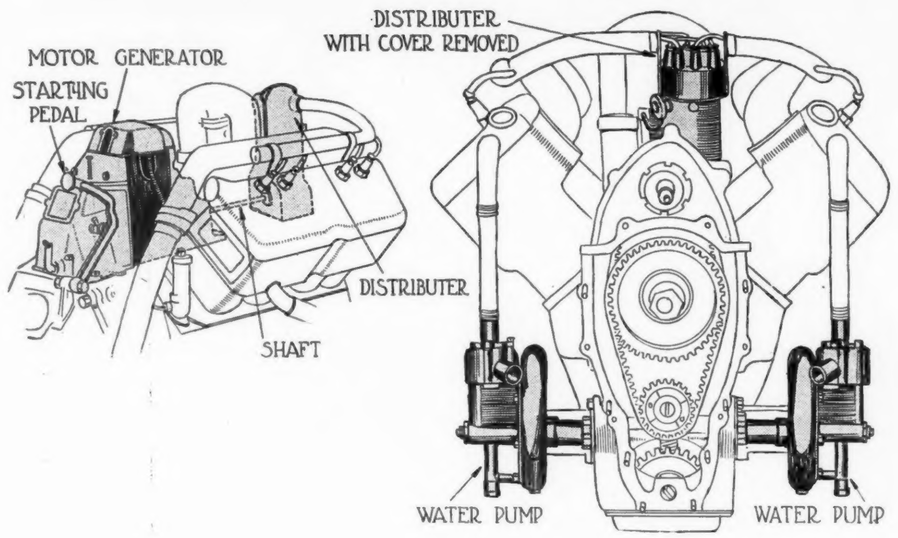


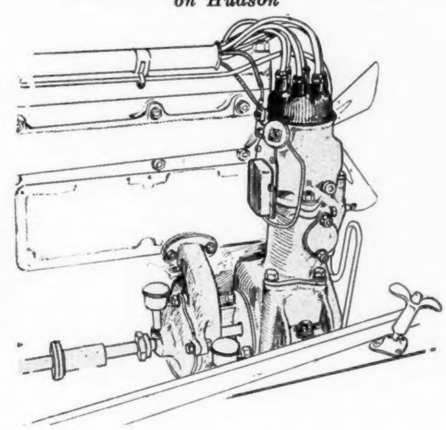
Left—Dodge uses a motor generator with the distributor drive on the pump shaft. Right—Marmon layout, showing generator, magneto drive with extra gear for tire pump





Left—Packard Twin Six with generator and water pump on one shaft, with distributor mounted on timing case. Right—An example of compact layout on the Nash, the generator and fan being one unit and the water pump mounted on the end of the camshaft





Left—A good example of balance drive is shown in the Cadillac Eight, with the water pumps mounted on a cross shaft and the motor generator and distributor in the V. Right—Pump and ignition unit mounting employed on Hudson

ried out quite completely in V-shaped engines where the duplicated members can be balanced on opposite sides of the crankshaft, while the single members can be put on the center line of the engine. The example shown herewith of the Cadillac illustrates this very clearly. The two water pumps are on opposite sides of the engine, with the distributor and the motor generator mounted on the center line between the V.

Starting motor supports are better this year than they have ever been before. The necessity for rigidity has always been recognized, but the methods of securing it have not always been as well thought out as they should have been. On the Paige car the flange system is clearly illustrated, in which a substantial flange on the end of the starter housing bolts direct against the bell housing of the engine, giving a connection which is capable of withstanding the torque needs in cranking the engine.

A somewhat similar system to this is used in Packard, which is also bolted to the bell housing. On the Hupmobile this style of mounting is used for both the starting motor and the generator, with the starting motor bolting against the bell housing and the generator bolting against the front chain case. On the Oldsmobile a reversed system is used, with the starting motor mounted behind the fly-wheel to a flange on the clutch housing.

The practice of using the fan belt to drive other units is not confined to the generator. On the Oakland the water pump drive is also secured from the fan belt. On the Maxwell the pulley on the end of the camshaft drives the fan belt, which is also connected with the motor generator by means of a long shaft with a flexible coupling. This gives a triangular layout for the drive of the two members.

Various means of driving the distributor have been used successfully. Overland and Paige take the drive off the pump and generator shaft. In both these instances this same shaft runs continuously, forming the means of driving the fan pulley, distributor, water pump and generator. Very much the same idea is used by Dodge and Marmon, with the exception that the Dodge uses a motor generator and the Marmon a magneto. The drive is also similar in some respects on the Case 40, except that the fan pulley in this instance is not on the same shaft, but the generator and coil are located with the distributor along the side of the engine.

The Nash gives a very good example of compactness in drive, with the generator mounted on the camshaft, combining two units at that point, and the water pump mounted directly on the same shaft, doing away with any intermediate units at this point. The distributor is driven direct from the camshaft also, so that there is no exterior shafting nor any extensive timing gear set.

Choosing a Name Scientifically

IT would be interesting to know the circumstances which led to the adoption of many of the most popular and best known names in the motor car industry. The combination of initials which form a word is very common with the Italian makers, as witness F.I.A.T., S.P.A., S.C.A.T., etc. When the F.I.A.T. Co. was formed it was decided to adopt a title which would fully explain the nature of the business and the location of the firm, and *at the same time* to get such a combination of initials as would form a readily-remembered word. This was no easy matter, dozens of combinations being obtained without anything satisfactory being arrived at. The best combination appeared to be Fabbrica Italiana Automobili, the initials of which gave the word Fia. This was placed on the office wall, together with a number of others, with a view to soliciting suggestions from all comers. Probably the word Fia would have been adopted, when some stranger entered the office and wrote after the title the word "Torino," followed by a big interrogation mark. This was a happy thought, for the factory was being established in the town of Turin, and the four initials gave the word F.I.A.T., a word which is easily pronounced in all tongues, which is readily understood in all languages, and which most appropriately applies to a motor car. While a "Fabbrica Italiana Automobili Torino" car would have been just the same as a F.I.A.T., it is certain that the production would have been handicapped if it had gone forth with such an unwieldy title.

Philippine Tractor Need Grows

LONG continued ravages of rinderpest have reduced the number of carabas, the common beast of burden in the Philippines, and the continued expansion of agriculture in the islands is creating a good demand for a light farm tractor to sell at a reasonable price. Purchases of heavy tractors which sell at high prices will be limited to a few of the larger haciendas, but the market for light tractors for small planters and co-operative groups will be general. So far no such tractor introduced into the islands has been satisfactory. Manufacturers can reach this market either by forming connections with a machinery house now in business here or by sending their representatives into the field.

Comparison of Average American Car for 8 Years

General Averages	1918	1917	1916	1915	1914	1913	1912	1911	1910
Horsepower, S.A.E. rating	27.4	24.3	28.66	29.97	33.2	33.60	33.60	32.7	31.5
Bore	3.43	3.37	3.57	3.82	4.12	4.19	4.34	4.42	4.85
Stroke	4.94	4.66	4.97	5.10	5.28	5.15	4.97	4.46	4.68
Stroke bore ratio	1.25	1.38	1.39	1.33	1.28	1.23	1.09	1.01	1.03
Displacement	26.9	222.5	278.87	307.38	349	345	316.2	313.2	281.5
Wheelbase	120.7	113.25	119.56	122.19	121	122	121	114	112
Gear ratio	4.22	4.15-1	4.08-1	3.88-1	3.6-1	3.57-1	3.62-1	......	......
Tires	34x4	31x4	23x4½	34x4	35x4½	35x4½	35x4	34x4	34x4
Number cars	......	......	519	535	607	......			
Number chassis	180	188	176	200	236	339	381	393	364
Number makes	125	131	108	119	133	156	193	270	239
Price	$1822	$1687	$1600	$2005	$2635	$2585	$2508	$2560	$2214
PERCENTAGE									
Number of Cylinders									
One cylinder	0	0	0	0	0	0	1	1	5
Two cylinders	0	0	0	.5	1	1	1	2	3
Four Cylinders	34.61	37	39.2	51.0	54	62	78	80	82
Five cylinders	0	0	0	0	0	1	1	0	0
Six cylinders	51.76	47	45.8	47.5	45	36	19	17	10
Eight cylinders	10.22	12	12.6	1.0	0	0	0	0	0
Twelve Cylinders	3.41	4	2.4	0	0	0	0	0	0
Shape of Cylinders									
L cylinder type	22.2	20	13.7	16.5	30	31	30	22	20
V motors	63.5	73	73.3	70.0	59	56	55	60	56
T cylinder type	6.8	5	13.0	8.5	6	9	9	14	18
Knight type	4	2	3.6	3.0	3	3	2	1	0
Two cycle	0	0	0	1.0	1	1	4	3	6
Mondex Magic type	0	0	0	0	1	0	0	0	0
Gasoline electric	0	0	1	0	0	0	0	0	0
H	2.3								
F	1.2								
Cooling									
Air colled	0.6	1	.6	.5	2	4	5	6	7
Thermo syphon	32.4	38	38.2	27	19	17	19	28	23
Pump circulating	67.0	61	61.2	72.5	79	79	76	66	70
Ignition Systems									
Single ignition	91.04	84	76.0	56	23	15	14	18	25
Dual Ignition	2.14	9	19.2	36	59	68	63	53	40
Two spark	1.14	1	1.2	1.45	4	2	0	0	0
Double	5.12	3	1.8	4.55	11	15	23	29	35
Duplex	.56	3	1.8	2.0	3	0	0	0	0
Engine Lubrication									
Splash oiling	57	35	52.7	46.5	42	53	68	81	0
Splash pressure	71.6	35	23.35	16	39	32	20	0	0
Oil in fuel	0	0	0	0	1	1	2	3	6
Pressure oiling	26.7	30	23.35	37.5	18	14	10	19	0
Splash gravity	1.19	0	.6	0	0	0	0	0	0

General Averages	1918	1917	1916	1915	1914	1913	1912	1911	1910
Engine Starting									
Electric starter	99.4	99	98.8	94.5	87	37	2	0	0
Acetylene starter	0	0	0	0	1	14	0	0	0
Air	0	0	0	0	4	9	2	1	1
Optional	0	0	0	1.5	2	5	0	0	0
Mechanical	0	0	.0	.5	1	4	0	0	0
No starter stock	0.6	1	1.2	2.5	5	31	98	99	99
Fuel Feed									
Gravity	9.7	18	31.8	57	58	65	75	81	82
Gravity pressure	..	1	2.4	.5	1	0	0	0	0
Pressure	6.8	7	12.0	22	41	35	25	19	18
Vacuum	83.5	74	53.8	20.5	0	0	0	0	0
Gas Tank Location									
In cowl	......	......	No	7.2	13	......	......	......	......
At rear	......	......	1916	51.1	41	......	......	......	......
Under seat	......	......	figures	21.2	46	......	......	......	......
			avail.						
Type of Clutch									
Disk	73.8	68	53.4	51	48	52	44	51	49
Cone	25.64	30	45.6	44	41	45	52	47	39
Expanding band	0	0	0	.5	3	1	3	2	6
Contracting band clutch	0	0	0	4.5	5	2	1	1	3
None	0	1	0	....	3	....	....	....	....
Electric	0	1	1.0	......	......	......	......	......	......
Location of Gearset									
Amidship	17.6	14	20.6	32.5	39	46	55	67	75
Unit with axle	7.37	9	15.3	18.2	15	20	20	17	15
Unit with motor	71.2	77	63.5	49.3	43	34	25	16	10
None	0	......	0	......	3	......	......	......	......
Infinite	0	......	6	......	......	......	......	......	......
Final Drive									
Shaft and bevel	18.32	28	41.0	84.5	93	94	92	91	89
Chain	1.7	1.5	1.7	4.5	4	4	6	8	11
Shaft and worm	0.56	0.5	.5	1.5	1	1	1	0	0
Roller	0	0	0	0	1	1	1	1	0
Shaft spiral bevel	79.42	70	56.8	9.5	1	......	......	......	......
Type of Axle									
Floating	42.35	43.5	51.8	56.5	65	67	50	0	0
Semi-floating	26	25.5	23.6	23.0	17	26	49	0	0
Three-quarter	30.5	29.5	22.8	18.5	14	4	0	0	0
Seven-eighths	......	0	0	0	1	0	0	0	0
Dead	1.15	1.5	.6	2.0	3	3	1	0	0
Timing Gear Drive									
Spur Gear	2.27	4	8.4	16.1	13	83	......	......	......
Helical or spiral	79	74	73.0	73.7	77	10	......	......	......
Silent chain	17.6	21	18.1	9.1	10	7	......	......	......
Worm	0	1	.5	1.1	0	0	0	0	0
Bevel	1.13	......	......	......	......	......	......	......	......

Models Listed by Manufacturers for 1918, 1917, 1916 and 1915, Showing Changes in Proportion of Sixes, Fours and Other Engine Types

Car	VARIETIES OF ENGINE MANUFACTURED 1918			1917			1916			1915		
Abbott		6			6			6	8	4	6	
Aland				4								
Allen	4			4			4			4		
American		6			6							
Ams Sterling	•			4								
Anderson		6			6							
Apperson		6	8		6	8		6	8	4	6, 6, 6, 6	
Arbenz	4			4			4			4		
Auburn		6			6, 6		4	6, 6		4	6, 6	
Austin			12			12						
Bell				4			4					
Biddle	4			4			4					
Bour-Davis	4	6			6							
Brewster	4			4			4					
Briscoe	4			4			4		8	4		
Buick	4	6		4	6			6, 6		4, 4	6	
Cadillac			8			8			8			8
Cameron					6							
Campbell	4											
Case		6		4			4			4, 4, 4		
Chalmers		6			6, 6			6, 6, 6			6, 6	
Chandler		6			6			6			6	
Charter Oak					6							
Chevrolet	4		8	4		8	4, 4, 4, 4			4, 4		
Cole			8			8			8	4	6	
Columbia		6										
Commonwealth	4											
Comet		6										
Crawford		6										
Crow-Elkhart	4			4			4			4, 4	6	
Cunningham			8			8						
Daniels			8			8			8			
Davis		6			6, 6			6, 6		4	6	
Detroiter					6		4			4		
Disbrow	4											
Dispatch	4			4			4					
Dixie				4								
Dodge	4			4			4			4		
Dorris		6			6			6, 6		4		
Dort	4			4			4					

Car	VARIETIES OF ENGINE MANUFACTURED											
	1918			1917			1916			1915		
Drexel				4								
Drummond						8						
Elcar	4	6		4								
Elgin		6			6							
Emerson				4								
Empire	4	6		4	6		4	6		4		
Enger						12			12		6	
Fageol		6										
Fergus		6										
Fiat	4			4			4	6		4	6	
Ford	4			4			4			4		
Franklin		6			6			6			6	
F.R.P	4			4			4			4		
Geneva					6							
Geronimo	4	6										
Ghent		6										
Glide		6			6			6		4		
Grant		6			6			6		4	6	
Hackett	4			4								
HaL			12			12			12			
Hatfield				4								
Harroun	4			4								
Harvard	4			4			4					
Haynes		6	12		6	12		6, 6		4	6, 6	
Hollier		6	8		6	8			8			
Homer-Laughlin			8			8						
Howard					6							
Hudson		6			6			6			6, 6	
Hupmobile	4			4			4, 4			4, 4		
Inter-State	4			4			4			4		
Jackson			8			8	4		8, 8	4	6	
Jeffery				4	6		4	6		4	6, 6	
Jones		6			6							
Jordan		6			6							
Kent				4								
King			8			8			8, 8	4		8
Kissel		6	12		6, 6		4	6		4	6, 6, 6	
Kline		6			6			6			6, 6	
Lambert				4	6							
Laurel				4								
Liberty		6			6							
Lexington		6			6, 6		4	6, 6			6, 6	
Locomobile		6			6, 6			6, 6			6, 6	
Luverne					6			6			6	
Madison		6			6			6				
Maibohm	4	6		4								
Majestic						8, 8						
Marion-Handley		6			6, 6			6				
Marmon		6			6			6			6, 6	
Maxwell	4			4			4			4		
McFarlan		6			6			6, 6			6, 6	
Mercer	4			4			4			4		
Metz	4			4			4			4		
Mitchell		6			6, 6			6	8	4	6, 6, 6	
Monitor		6		4	6							
Moline-Knight	4			4, 4			4			4,4		
Monroe	4			4, 4								
Moon		6			6, 6			6, 6		4	6	
Moore	4											
Morse				4			4			4		
Murray			8			8						
Napoleon				4								
Nash		6										
National		6	12		6	12		6, 6	12		6	
Nelson	4											
Oakland		6			6	8	4	6	8	4	6	
Ogren					6							
Oldsmobile		6	8			8	4		8	4	6	
Olympian	4											
Overland	4	6		4, 4	6		4, 4	6		4, 4	6	
Owen-Magnetic		6			6, 6			6, 6			6	
Packard			12			12			12		6, 6	
Paige		6			6, 6			6, 6			6	
Pan American		6										
Partin-Palmer				4, 4			4, 4		8	4, 4		
Paterson		6			6			6		4	6	
Pathfinder						12		6	12		6	
Peerless			8			8			8	4	6, 6	
Pennsy	4	6										
Phianna	4			4								
Pierce-Arrow		6			6, 6, 6			6, 6, 6			6, 6, 6	
Pilot		6			6			6, 6, 6	8		6, 6	
Premier		6			6			6			6	
Princess	4			4								
Pullman				4			4	6		4	6	
Regal	4			4		8	4, 4		8	4		
Reo	4	6		4	6		4	6		4	6	
Richmond					6							
Roamer	4	6			6							
Ross						8			8, 8			
Saxon	4	6			6		4	6, 6		4	6	
Sayres		6										
Scripps-Booth	4		8	4		8	4		8	4		
Seneca	4											
Shad-Wyck		6										
Simplex		6			6		4, 4	6		4, 4		
Singer		6			6			6			6	
Standard			8			8, 8		6	8			
States		6										
Stearns-Knight	4		8	4		8	4	6	8	4, 4	6	
Stevens		6			6							
Studebaker	4	6		4	6		4	6		4	6	
Stutz	4			4			4, 4			4, 4, 4	6, 6	
Sun					6							
Templar	4			4								
Tulsa	4											
Velie		6			6, 6			6, 6		4	6, 6	
Westcott		6			6			6, 6		4	6	
White	4			4			4, 4			4, 4		
Willys-Knight	4	6	8	4	6	8	4			4		
Winton		6			6, 6			6, 6			6	
Wolverine	4											
Woods	4			4								
Yale			8			8						

Piston Refinements Increase Weight

Tolerance Limits Are Close, Even in Commercial Practice of Large Production Companies—Limit of Lightness Passed

PISTON weights show no tendency to decrease further. Rather in a few instances the weights have been increased in order to secure additional stiffness. It would almost be indicated from this that the prominence given to light reciprocating parts led some of the engineers to rather overshoot the mark in this respect. One of the prominent eight-cylinder manufacturers in Detroit used pistons which weighed last year, at the beginning of the season, 15 oz., minus the wrist pin and rings. This company has been forced to increase the weight of these pistons, due to inability to obtain stiffness, so its pistons now weigh 1 lb. and 3 or 4 oz. This is a cast-iron piston.

It is also true that the aluminum pistons are being made heavier, and this is in line with aeronautical practice abroad, where the aluminum pistons are at least as heavy as cast iron, but are employed because of their ability to rapidly carry off a great quantity of heat. From all accounts, it would seem that the bottom of the weight scale in pistons was reached at the end of the year 1916, and during 1917 there has been a tendency to either remain stationary or go slightly upward.

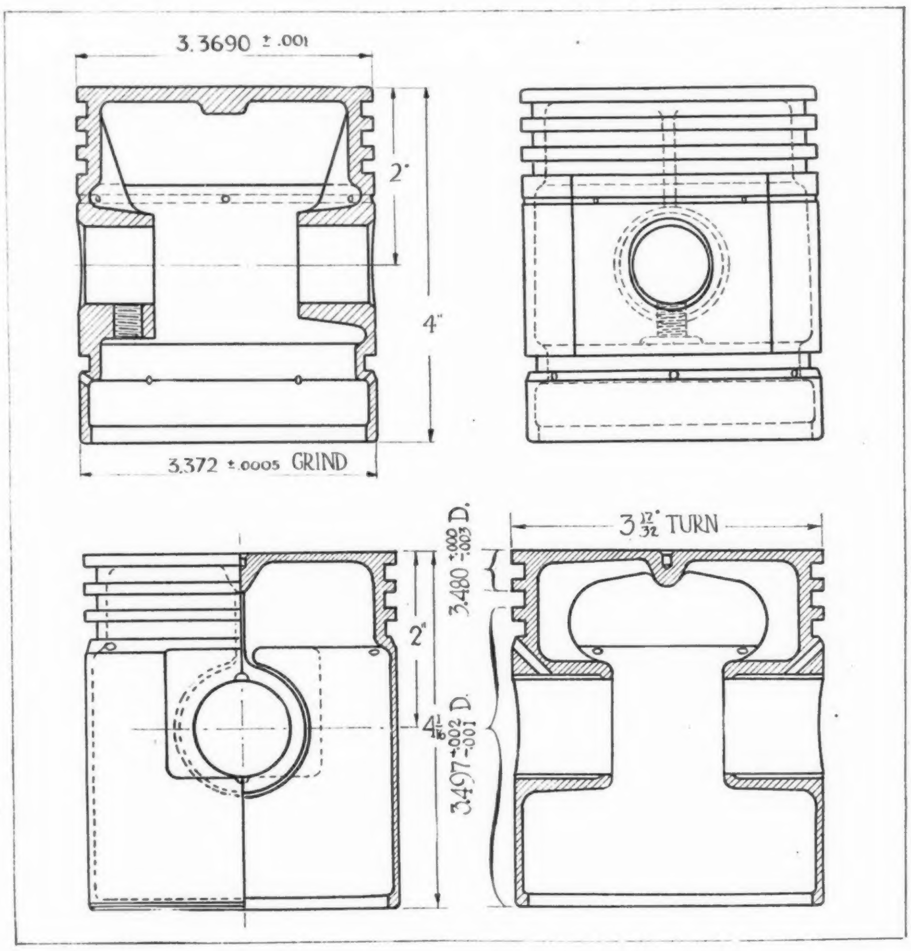
For example, the Hudson company, which decreased the weight of their pistons to a noticeable extent until the end of 1916, at which time a weight of 30 oz. was reached, including rings, will now keep the same weight piston for 1918. On the other hand, the Cadillac company has added about 5 oz. to its piston weight. The weights of the Willys-Overland pistons as measured on Nov. 12, 1917, are given in the table herewith:

Weights of Standard Pistons

Model 89-6 H.A. 306		
Cast Iron Diam. 3½ In.		
1—2.06 lb.	1—2.12 lb.	1—2.04 lb.
1—2.08 lb.	1—2.06 lb.	1—2.04 lb.
Model 88-8, No. 26038		
Aluminum Alloy Diam. 3⅜ In.		
1—0.66 lb.	1—0.68 lb.	1—0.72 lb.
1—0.56 lb.	1—0.72 lb.	1—0.72 lb.
Model 88-4, No. 25596		
Cast Iron, Diam. 4¼ In.		
1—2.90 lb.	1—2.80 lb.	1—2.84 lb.
1—2.90 lb.	1—2.80 lb.	1—2.84 lb.
Model 90, No. 19277		
Gray Iron, Spec. No. 12 Diam. 3⅜ In.		
1—2.20 lb.	1—2.20 lb.	1—2.16 lb.
1—2.20 lb.	1—2.18 lb.	1—2.14 lb.

It is very possible, also, that a gain in weight has been due to the tendency to increase the number of rings to three at the top of the piston, or of adding a wiper ring at the bottom. This tendency has been caused by the trouble due to leakage of fuel past the piston rings as much as it has been to the desire to prevent the leakage of oil into the combustion chamber after the engine has become warmed up.

Another point on piston design which may be commented upon is the tendency toward closer limits. It would not be surprising to learn that this tendency is a development from airplane practice, because fits are certainly much closer since the art of building racing and aircraft engines has advanced. A sample of what is required in piston manufacture may be mentioned, the practice cited being that of one of the most prominent manufacturers of six-cylinder cars in Detroit. The piston, which is 3 11/32 in. in diameter, has a clearance of 0.0035 in. after running-in. The maximum out-of-round tolerance for lands and barrels is not more than 0.001 in. The diameter of the piston barrel must be maintained in relation to the diameter of the two top lands, with a tolerance of plus nothing and minus 0.001 in. The thickness of the walls and the wall under the ring grooves must be maintained within plus 0.005 and minus 0.015. The weight of the piston must be between 29 and 32 oz. The pistons are to be balanced in groups of six, and the variation between the heaviest and lightest must not exceed ½ oz. The piston pins have a maximum clearance of 0.0015 and a minimum of 0.0005.



Above—Typical piston which shows the tendency toward an increased number of rings. This has three above the wrist pin and a wiper ring below the wrist pin. Below—Section through the piston used in the Hudson 1918 car

Commercial Crankshaft Balancing

Machine Vs. Design Balancing of Crankshafts—Two Schools Not Influenced by Cost but by Engineering Belief

By J. Edward Schipper

WHEN the crankshaft balancing question began to assume serious proportions, due to increased rotative speeds, considerable discussion was started as to why the various methods suggested could not be put into practice on regular production jobs. At the present time this matter has been threshed out to two common methods, the first being where the dynamic balancing of the shaft is a part of its design and consequently no machine treatment is afterward necessary, and the second method where some type of machine is used to secure the dynamic balance. Manufacturers are divided between these two schools quite evenly in both the higher and lower-priced cars.

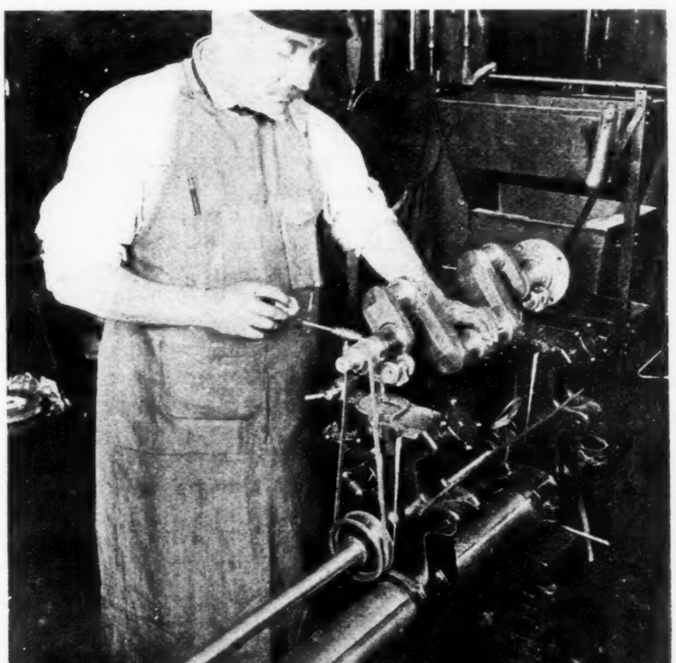
Packard does not use any balancing machine, but gets the shafts into proper running balance by machining them all over to very close limits. The theory is that after the balance is carefully figured in the design of the shaft and then the shaft is accurately machined to those figures, a perfectly satisfactory result will be secured. This type of engine, being a high-speed, twelve-cylinder design, representative of higher-priced cars shows that this is done not as a matter of cost, but because it is what is believed to be correct engine practice.

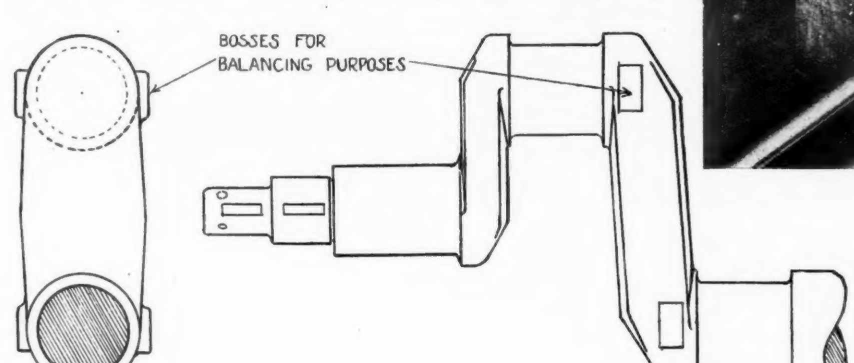
Maxwell Uses Design Balance

Another concern at the opposite end of the price scale which takes very much the same view of the situation is the Maxwell Motor Co. The Maxwell shafts are given only a static balance. During the process of designing the crank, however, the matter of dynamic balance was taken into account, and it was so constructed that it requires the removal of a very small amount of metal to bring the shaft into static balance. Since, theoretically, the inherent design of the crank is such as to bring it into dynamic balance, it is thought that the slight amount of metal removed to secure static balance does not affect this particular engine to any extent.

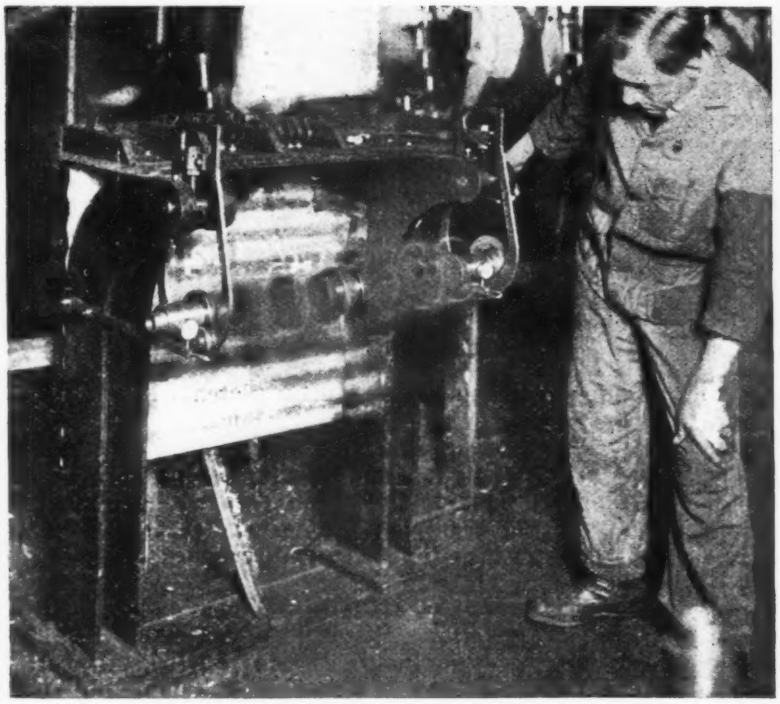
In the Hupp laboratory, experiments made by the engineering department have led this concern to doubt the practicability of dynamic balancing and also its usefulness upon touring-car engines. The reason for this as assigned by the engineering department is that the flywheel of automobile engines contains a clutch which is practically impossible to balance dynamically, for two reasons: First, because the parts of the clutch are not centered exactly with the crankshaft; second, because at least one element of the clutch does not maintain its phase with the crankshaft, but usually takes a different position every time the clutch is disengaged and engaged again.

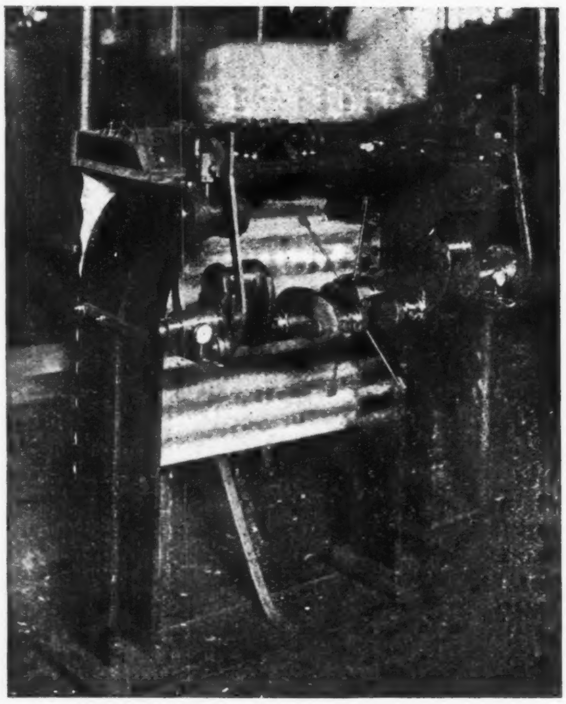
The Hudson crankshaft is so well known that it needs no further discussion. It is built in accordance with the disclosure contained in the Fekete re-issue patent No. 14,292, and its balance is a matter of design and not of any special procedure in the course of its manufacture. On production jobs the Hudson company tests the crankshaft for static balance by balancing it on knife edges, but otherwise does nothing in the way of special balancing procedure. It is claimed that dynamic balance is maintained beyond the range of speeds of which the engine is capable.





Left — Drawing of the Willys-Overland crankshaft, showing how the bosses are left upon the shaft for balancing purposes. Above—Willys-Overland shaft placed in the Norton balancing machine being marked for excess metal





Left—Shaft being rotated in the Continental air-operated balancing machine. Right—Shaft in position in the Continental air-operated machine before air is turned on. The shaft is rotated by attaching a small paddle wheel on which a jet of air is played

Other manufacturers use machines in this work. The Studebaker Corp., for instance, uses a mechanical balancing method commonly known in the manufacturing field, the machine being the standard Norton balancing outfit. The Studebaker crankshafts, after forging, machining and grinding, are checked for alignment of bearings. They are then placed on the Norton machine and tried out for rotating or dynamic balance. The crankshafts are then marked as to where excess material should be removed, and upon taking off the desired amount of material, are again tested, the operation being repeated until the crankshaft is in balance. This method is stated by the Studebaker Corp. to be entirely satisfactory from both an engineering and production standpoint.

Very much the same method is used by Willys-Overland. The illustration herewith shows the application of the Norton machine in the Willys-Overland factory, with the workmen in charge marking on the shaft the place at which it is necessary to take off metal. The accompanying drawing of the Overland crankshaft shows the bosses which are left upon the shaft for balancing purposes. The desired amount of metal can be trimmed off these bosses without in any way impairing the strength of the shaft. They are ground down until the proper balance is secured.

The Oakland Motor Car Co. is using the Norton machine at the present time, but is experimenting on a new and original method of balancing, which will be described in an early issue of AUTOMOTIVE INDUSTRIES.

The method used by the Chevrolet Motor Co. is somewhat different. This concern has a fixture with four hardened and ground steel disks, which are about 1/8 in. thick on the outer edge and 5¾ in. in diameter. These disks are used as rollers on which the crankshaft is rotated while balancing. They are pivoted in pairs with center-to-center distance of pivots 3⅝ in., giving a pressure angle or contact point between the shaft bearing and the roller of about 45 deg. These two pairs of rollers are a proper distance apart to bring them in the center of the front and rear bearings when the crankshaft is placed upon them.

The shaft is thus tested for static balance, which must be within a limit of 1½ oz. This is obtained by means of a 1½-oz. weight which is held by spring-steel clips, the clip being sprung over the center bearing, bringing the weight 2 in. from the center line of the shaft, or in line with the center of the wrist pins, as on this particular design the crank has a 4-in. stroke.

The forgings are made with small bosses forged on either side of web or section of shaft between wrist pins, and when the shaft does not balance within the specified limit these bosses are ground off until the balance is restored.

An ingenious method used by the Le Roi Motor Co. is to suspend the crankshaft at one end by a flexible cord. The shaft is then rotated rapidly, and if it rotates accurately about its own axis, it is in dynamic balance. On the other hand, if it wobbles from side to side the ends are heavier than the center. If it tends to rotate so that its axis generates a cone about the point of suspension, it is heavier at the bottom, and if it tends to generate an inverted cone, it is heavier at the top. This method is cheaply installed and forms a good way of commercially balancing crankshafts.

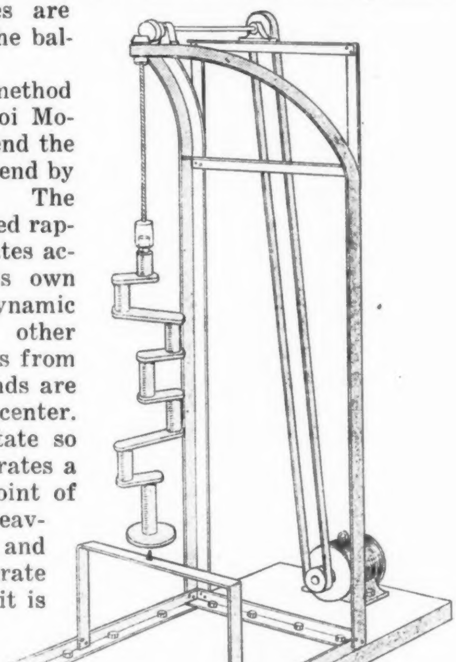


Diagram showing suspension method of balancing used by the Le Roi Co.

Impulse Starters for Tractors

Enable a Starting Spark to Be Obtained Without Spinning Engine—A Number of Designs Offered, Differing in Type of Spring Used and in the Form of the Detent Mechanism

AT the present time magneto ignition is the accepted practice in tractor engineering. Tractor engines run up to very large sizes, which it is entirely impossible to spin by hand. A set of dry cells with some auxiliary mechanism would serve to give a hot spark even if the engine were cranked over very slowly, but ignition engineers familiar with the conditions under which tractors are operated prefer to do without dry cells. The inability of the ordinary magneto to furnish the one spark required for starting was certainly a great handicap in the field of slow speed engines, but magneto engineers did not let the difficulties attached to the solution of the problem involved stand in their way and produced magnetos which will generate firing sparks no matter how low the cranking speed.

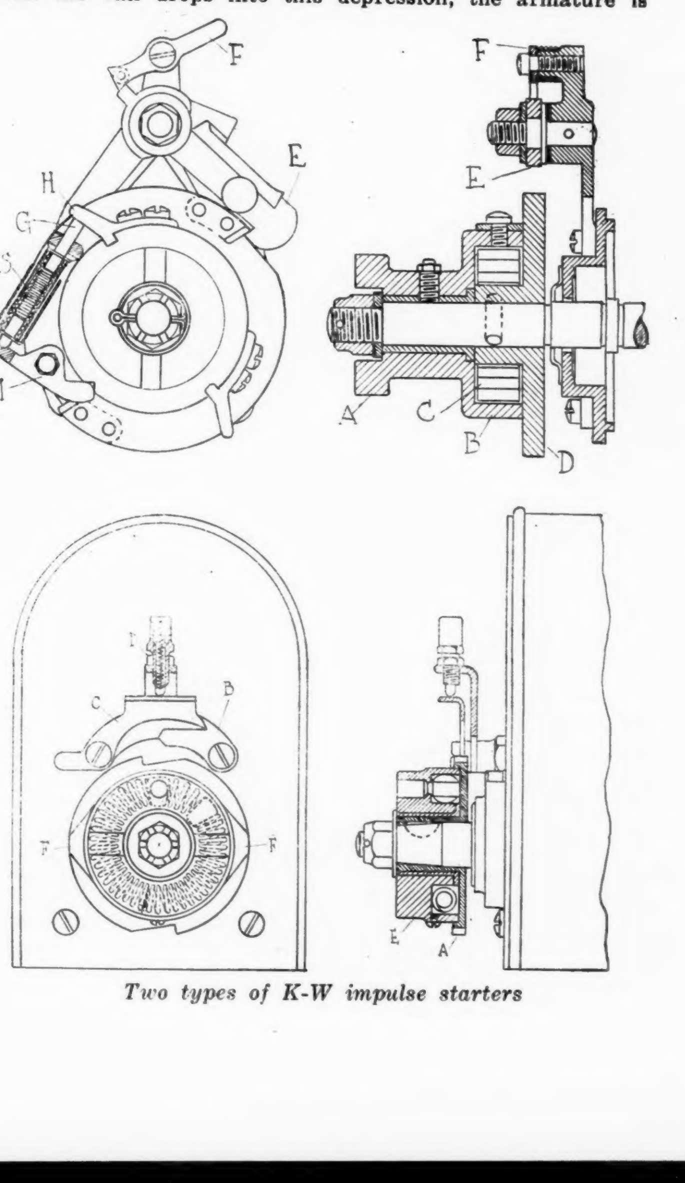
Originally the alternating current ignition magneto was developed for automobile service, and an automobile engine can be cranked sufficiently fast to cause the magneto to generate a firing spark. Even so, it was much easier to start the engine on battery current, as this required merely turning the engine over the dead center, and in this country it became customary to use dual or double ignition, which combined the use of battery current for starting with magneto current for regular running.

The problem of devising some means for obtaining a hot spark from a magneto at low speed first presented itself when this device was applied to stationary engines. These engines often run at such low speeds that a magneto geared to them in such a way as to produce no more than the number of current impulses per unit of time required to fire the charge would be operating at very low efficiency. The ordinary revolving armature magneto produces two impulses per revolution of its armature, and a single cylinder, four stroke engine requires only one spark every two revolutions of its crankshaft. Hence the proper gear ratio would be such that the magneto armature made one revolution to every four of the engine crankshaft. The impracticability of operating a magneto armature only a couple of inches in diameter at, say, 50 r.p.m. is quite apparent. It is, of course, the speed of the armature at the moment the circuit is broken that really counts, and not the average speed in driving the armature from the engine crankshaft at a uniform speed. The expedient was resorted to of partly rotating the armature in its bearings against the tension of a coiled spring, then suddenly releasing it by means of a tripping device and allowing the armature to flop back under the tension of the spring. In this way very considerable momentary armature speeds were obtained. The principle is made use of not only for starting but in regular operation as well.

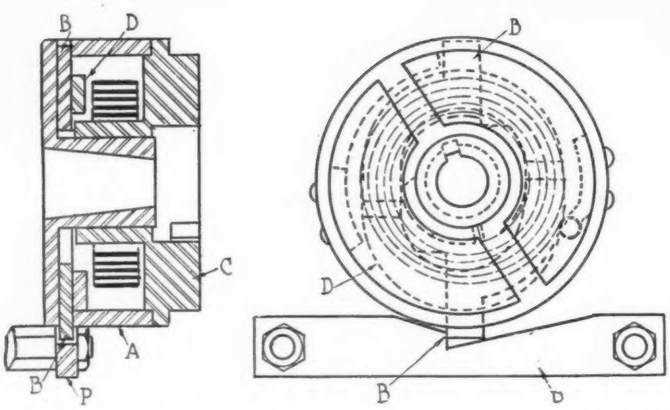
For use in engines which in regular operation run at considerable speeds such a tripping mechanism would hardly be considered, because at higher speeds inertia begins to play an important part, and there are, of course, no inertia forces to be taken account of in a machine rotating at uniform speed. This applies to tractor work. The normal speed of tractor engines is quite sufficient to make it practical to drive a magneto directly, but the difficulty of cranking these engines by hand calls for a device whereby the armature speed can be momentarily accelerated when cranking. Such a device is known as an impulse starter and at present all of the magneto manufacturers catering to the tractor trade either offer such a starter or are working out the details of one.

An impulse starter is a device whereby the magneto armature can be held stationary in a certain position while a spring is being wound up or compressed by the motion of the engine; when the spring has been put under the proper pressure a detent operates and causes the armature to be accelerated by energy stored in the spring. This insures the necessary hot spark for starting. The detent device must be so designed that when the engine runs at normal speed it does not catch and the magneto is driven without change in the timing.

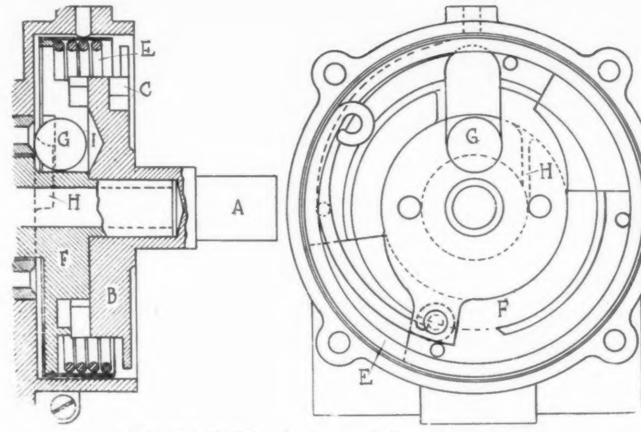
While at present impulse starters are used mainly on tractor engines, the first starter of this type, it seems, was designed for use on automobiles. At least some 10 years ago J. S. Bretz & Co. of New York imported a magneto known as the U. & H. which embodied this feature. Two views of this starter are shown herewith. The driving shaft *A* is formed with an integral disk *B* which at one point of its circumference carries a pin *C* to which one end of the coiled spring *E* is anchored. The other end of this spring is attached to a brass disk *F* secured to the magneto armature. Disk *F* is of irregular shape and is provided with a radial slot containing a steel ball *G*. When disk *F* turns righthandedly the steel ball *G* abuts against a projection *H* on the stationary armature housing. The result is that when shaft *A* is rotated, spring *E* is wound up, and this continues until a conical depression *I* in disk *B* comes opposite the steel ball. Then the ball drops into this depression, the armature is



Two types of K-W impulse starters



Kingston impulse starter



The U & H, pioneer of impulse starters

suddenly released, the spring unwinds and gives the armature a considerable speed, thus producing a relatively hot spark. The projection or cam H is so arranged on the circumference of the field pole circle that the unwinding of the spring begins when the armature comes into the arc of the greatest inductive effect. When the engine attains its normal speed the steel ball is carried to the outer end of the slot in disk F by centrifugal force and does not strike projection H in its rotation.

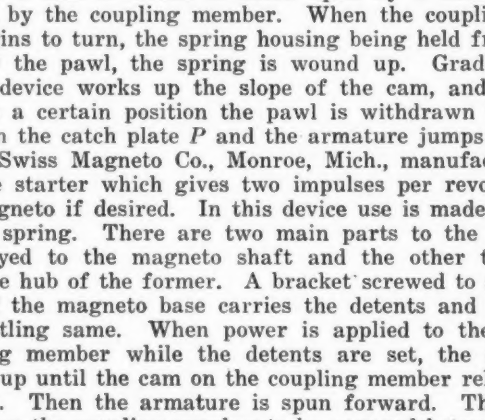
Probably the first American firm to get out an impulse starter was the K.W. Ignition Co. of Cleveland. The original K.W. impulse starter is shown on page 23. Combined with the clutch member A is a spring case B in which there is a spiral spring C whose ends are fastened to the spring case and to the ratchet disk D respectively. The latter is solid with the armature shaft, to which it is pinned. A pawl E pivoted on the magneto frame is adapted to engage into the notches on the ratchet disk D. On the circumference of the spring case B there are two knock-off cams G which when the spring case is turned while the ratchet disk is being held stationary will force the pawl out of the notch on the ratchet disk and release the latter. When once released the pawl is held out of contact with the ratchet disk by the lock F. As soon as the ratchet disk is released, it and the armature are spun rapidly by the spiral spring. As the engine is being cranked the clutch member A and spring case B are turning at a certain speed, but the ratchet disk D jumps ahead of the case B with the result that the knock-off cam abuts against a plunger G mounted on a cushion spring S on the ratchet disk. This same spring H serves to press the dog I into a notch in the outer surface of the spring case B. Before starting an engine fitted with this impulse starter the lock F must be pressed down so as to release pawl E. The reason for the double hook on pawl E and for two knock-off cams H turned in opposite directions is to adapt the starter for both right hand and left hand magnetos. The ratchet holds the armature back for a motion of the driving coupling of about 80 deg.

A somewhat different design of starter, in which a coiled spring is used to store up the energy for giving the impulse to the armature, is used by the K. W. Ignition Co. on its model T. K. magneto (page 23). In this model the ratchet disk A is held from rotating by pawl B, which can be held out of contact with the ratchet disk by catch C. A spring pressed plunger D normally holds the catch in engagement with the pawl. As in the previously described model, the coupling members and spring case are formed in one unit E, which is turned with a groove in its face in which the coiled spring lies. The spring is located between two stops, of which one is secured to the ratchet disk and the other to the spring case. There is a second small spring, acting as a buffer spring, which fills the rest of the channel in the spring case not occupied by the main spring. This buffer spring takes up the reaction when the ratchet wheel is released and the armature snaps forward. Disengagement of pawl B is effected by means of cam lobes FF on the outer surface of part E. The pawl is made of sufficient width so that its nose may engage both the ratchet wheel and the cams.

Another impulse starter is the Kingston made by the Kokomo Electric Co. Referring to this design the ratchet or slotted part is stationary and the pawl revolves. The sectional view shows the spring to be of the flat spiral type. The hub of the spring housing A is turned out to a taper to fit the magneto shaft. There is a double pawl, the teeth BB of which pass through slots in the outer wall of the spring housing. One end of the spring is secured to the housing and the other to the clutch member C, which latter has a hub telescoping the hub of the housing. Secured to the pawl is a cam D which is acted upon by a detent device carried by the coupling member. When the coupling member begins to turn, the spring housing being held from rotation by the pawl, the spring is wound up. Gradually the detent device works up the slope of the cam, and when it reaches a certain position the pawl is withdrawn from the notch in the catch plate P and the armature jumps ahead.

The Swiss Magneto Co., Monroe, Mich., manufactures an impulse starter which gives two impulses per revolution of the magneto if desired. In this device use is made of a flat helical spring. There are two main parts to the coupling, one keyed to the magneto shaft and the other telescoped over the hub of the former. A bracket screwed to an extension of the magneto base carries the detents and the lever for settling same. When power is applied to the Oldham coupling member while the detents are set, the spring is wound up until the cam on the coupling member releases the detents. Then the armature is spun forward. This causes a post on the coupling member to be engaged between a stop and a dog on the ratchet wheel, so that the timing cannot vary when the engine is running at normal speed.

From the detent lever connections can be made to any part of the machine, so the operator need not raise the hood to set the detents. As long as the driver pulls on this lever the impulse effect is obtained; hence the detents must be released as soon as the engine is started, as unnecessary use of the impulse device simply wears it and reduces the power of the engine.



General view of Swiss impulse starter

The War's Effect on the Industry

Economy Will Be the Keynote of Design—Miles-Per-Gallon a Greater Criterion Than Miles-Per-Hour—Excessive Flexibility Demands Must Be Dropped—Cheaper Grades of Fuel Will Have to Be Used

By A. Ludlow Clayden

War's influence on automobile design and on automobile merchandising was the general topic of discussion at the December meeting of the S. A. E. Metropolitan Section held at the Automobile Club of America on Thursday evening, Dec. 27. Of the two papers of the meeting, one, by A. Ludlow Clayden, engineering editor of AUTOMOTIVE INDUSTRIES, *is reprinted herewith. The other paper, How the War Will Affect the Automobile Dealer, was by Ray W. Sherman, editor of Motor World. A number of prominent New York dealers were present and took part in the discussion.*—EDITOR.

THERE are hardly any prophets left who will venture to predict the duration of the war. Lacking any definite ideas on this subject it is hard to anticipate the effect of the war on the American automobile industry in the ultimate. To make any sort of an analysis it is necessary to assume that the war will last a substantial time, a year or more at least.

If the war does not end before Dec. 27, 1918, the passenger car industry of this country will still be one of the greatest industries of the U. S. outside of munition making, which will be temporary. It will maintain its position because America is the world's automobile factory, just as China and India are the world's tea centers, just as Brazil is a coffee center. The United States is the logical place for the manufacture of the bulk of the world's supply of passenger cars, and as long as that is true, just so long will passenger car making be one of the mainstays of American trade.

War is having an effect upon every last detail of civilized life, and it is going to affect automobile design just as much as other things. We are to-day entering an era in which the highest ideal of a man or of a nation is the ideal of economy. Never before in history has economy been more admired than extravagance, never before has a change in public sentiment been made so swiftly. The American nation, a leader in so many things, has for fifty years been proud of the fact that its resources permitted it to be a leader in extravagance. Like the wealthy man who demands the best of everything, America has been the wealthy nation able to pay for whatever it wanted.

Now this is all changed. The admired man to-day is he who, though able to spend on personal gratification, holds back and contents himself with something smaller, giving the balance to the vital needs of the day. This is not only a temporary condition to end with the war. It is a condition which will last long after the war is over, a condition which is being impressed so strongly on the minds of the now adolescent generation that it may well become the ruling spirit of the next hundred years.

If these premises are sound, then the American passenger car of the near future is going to be one in which economy is a strong feature. **A car of which the first cost, plus the maintenance cost over a period of years, will make a good showing. We are about to exchange "what will she do on high?" for "what will she do to the gallon?"**

IT IS A FACT THAT ALREADY THOSE CARS WHICH HAVE A REPUTATION FOR ECONOMICAL OPERATION HAVE SUFFERED FAR LESS THAN THOSE WHICH ARE KNOWN AS WONDERFUL PERFORMERS.

The volume of passenger car business being done today represents little more than the essential trade which supplies transportation to those who need it. The whole agricultural life of the whole United States and a good half of the business life of small towns and large cities depend today upon passenger car transportation. The farmer's timetable of his week's work is laid out on a schedule that necessitates a car to get him from point to point. And on the city side, just imagine, say, Philadelphia bereft of passenger cars. Think of the utter impossibility of living in Philadelphia's residential districts without road transportation.

THE LAST TEN YEARS OF AMERICAN TOWN PLANNING HAS BEEN ON AN AUTOMOBILE BASIS.

THE AMAZING INCREASE IN AMERICA'S AGRICULTURAL OUTPUT IS DUE TO THE RAPIDITY OF GROUND COVERING PROVIDED BY THE AUTOMOBILE.

But the average American car has exacted too high a price for the service it rendered. Not too high a first price, but too high a maintenance price. It has been too big, too heavy, too powerful; too extravagant of fuel, of oil and of tires; too frequently in need of repair.

To take just one instance: it is absurd to utilize two tons of machinery to carry a man ten miles from his home to his office. It is equally absurd to provide his car with an engine which normally has a fuel efficiency of 10 per cent, when it could have a 20 per cent efficiency by sacrificing the ability to crawl on high gear.

I do not wish to quote the European example as in any sense a criticism; but it is true that European cars have been much less costly to operate. They have to be because of the much smaller average wealth. The English or French user simply had to consider running expense. He had to have an economical car or none. This is the reason why motor cycles have had such an immense vogue on the other side of the Atlantic. The average American says "*I* can't ride a motor cycle." "It isn't in keeping with my position; my friends would roast the hide off me." True enough last year—but will it be true next year?

Similarly it has been an ideal to have a huge car, an ideal fostered by advertising and by salesmen everywhere. Without doubt the big car has its comforts, but the little car has conveniences which more than counterbalance. Nobody who has tried both would ever choose a 140-inch wheelbase car for shopping in preference to a 110-inch one, provided both were of the same standard of engineering. At present engineers then have two ways to work—one towards a car which is more economical because it is smaller; another towards a car which is more economical because it is inherently better.

It is just a personal opinion, perhaps worth quoting in passing, that the greatest trade open to a magnetic system of transmission is in a car with about 110-inch wheelbase, a 200-cubic inch engine and made in a quality which will make its fair price around $2,000.

There is another thing. We are nearly at the end of gasoline as we know it. No doubt the fuel ten years hence will still be called gasoline, but it will not operate a 1918 gasoline car. We have got to learn to sacrifice the absurdities of "flexibility" existing in the modern engine in order to use a fuel which we will be able to buy for a third the present price. There is nothing to prevent a man lighting cigars with dollar bills if he wants to, but the world at large thinks it silly when matches are so cheap. At present the automobile is running on dollar bills instead of dimes, with little more real reason.

Scotland Favors Light Farm Tractors

Demonstrations Show That This Newer Type Machine Is More Suitable for Routine Farm Work Than Heavier Ones

EDINBURGH, SCOTLAND, Dec. 11—The following is practically the complete report of the special committee in conjunction with the three tractor demonstrations held in Scotland last October. The first of these demonstrations was held in Edinburgh, Oct. 17 and 18, the second at Glasgow, Oct. 22 and 23, and the third at Perth, Oct. 26 and 27. The following report is based on conclusions arrived at by the committee in conjunction with all three of these tests. In reading the report it should be borne in mind that relatively small areas were plowed due to the difficulty of securing large areas. The conclusions of the committee were published in a recent issue of AUTOMOTIVE INDUSTRIES.

The following is the report:

The committee was instructed, in preparing the official report on the demonstration, to give special attention to the following points:

a—Weight of machine.
b—Mechanical design and construction.
c—Quality of work.
d—Time taken and attendance required.
e—Adaptability for plowing different widths and depths.
f—Adaptability to various kinds of work, such as cultivating, harvesting, road haulage, and the like.
g—Ease and safety of handling.
h—Ease of turning, and space and time required for same, and uniformity of furrow ends in plowing.
i—Facility and efficiency of attachment of tractor to plow other farm implements.
j—Price.

Nature of Ground

The ground at the first demonstration consisted of a deep free loam, with occasional earth-fast stones. Part was in lea, part in stubble, and from part a potato crop had been taken. On the two larger fields, one of stubble and one of lea, there was a gradient, reaching at its steepest part 1 in 7. This gradient, which averaged about 1 in 12, occurred nearly equally throughout all the plots.

At the second test both stubble and lea were provided, but on account of extremely wet weather before and on the days of the demonstration it was found impracticable to attempt plowing of stubble. The lea field consisted of tough old grass land, which when last plowed had been set up in ridges, thus increasing the difficulty for multiple plows carried on frames which are adjusted by wheels. The gradients were not severe.

The ground at the third test consisted of a free loam overlying a clay subsoil, and was somewhat shallow on part of the rising ground. Both lea and stubble were provided. The lea field was practically level, as was also one of the stubble fields, although on this latter the conditions were rendered somewhat more severe through dung being spread on the surface. On two other stubble fields there were stiff gradients, averaging about 1 in 9, and reaching a maximum in places, and for short distances, of 1 in 5.2.

As there was a large number of entries, and it was desirable, for the convenience of visitors, that the machines should be seen at work within as small an area as possible, the plots laid off were smaller than might otherwise have been considered desirable. These varied in extent from about three-quarters of an acre to about two acres.

Prior to the demonstration, feerings were drawn by horse plows, and headlands were marked off twelve yards in width. At Edinburgh and Perth the system of plowing was entirely winding or scaling—*i.e.*, the tractor was required to plow out the land which lay between the feerings which bounded its plot. At Glasgow the machines were required to gather to the feering, which was in the center of each plot.

Conditions and Regulations

Exhibitors were left as free as possible to demonstrate the capabilities of their machines in the manner they considered most suitable. No restrictions were imposed as to the plow to be used, the number of furrows taken, or the speed of the tractor. The depth of plowing was, however, prescribed, and varied at the different centers from 6 in. to 8 in. for lea, and from 7 in. to 9 in. for stubble. Any machine which failed to plow to the required depth, or which was unable to perform the work to the satisfaction of the stewards and committee, was prevented from proceeding until the fault had been remedied.

Twenty-nine tractors took part in the demonstration. The number of plows was considerably greater, as several tractor exhibitors sent more than one plow, and a number of plow-makers entered plows independently. The report gives a detailed description of the machines, alphabetically arranged according to the names of the exhibitors, and then states:

Classification of Machines

The twenty-nine machines which took part in the demonstration may be grouped according to the following classification:

Wheels—
15 ran on 4 wheels.
6 " " 3 "
4 " " creeper tracks.
4 were single-unit machines (1 with creeper).
—
29

Attendance—
11 were handled by 2 men.
18 " " " 1 man.
—
29

Fuel—
25 were driven by paraffin.
3 " " " gasoline.
1 was " " steam.
—
29

Weight—
2 weighed 8960 lb. and over.
3 " 6720 " " "
6 " 5600 " " "
7 " 4480 " " "
3 " 3360 " " "
8 " under 3360 lb.
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29

Report by Official Observers

The decision of the directors that the demonstration should not be regarded as a competitive trial precludes the Reporting Committee from making any attempt to arrange the vari-

ous tractors exhibited in any order of merit. Even apart from this, however, they do not believe that the circumstances and conditions of any such demonstration would make possible any final judgment on the merits of various types of machines, since very important considerations could only be determined in a much more extended period than that which was available.

But while the committee cannot properly make such a report as would definitely advise intending purchasers in the choice of a tractor, they believe that the observations which follow may be useful in this direction, as well as in suggesting to engineers important respects in which agricultural tractors and plows may be made more useful in tillage operation.

Weight

With regard to weight, it will at once be apparent that, in many cases, the tractors shown have been evolved on the lines of the heavy steam tractor. The most noteworthy feature of the present demonstration was the appearance of the light land tractor constructed on new lines. Several manufacturers appear to have departed from the idea that great weight is necessary for a tractor to do efficient work on the land. It was clearly shown at the demonstration that light machines, adequately provided with spuds, grip the ground and perform the work better than the heavier machines. Every drawback, such as slipping in soft land and inability to climb gradients, was aggravated by increase of weight above a certain limit. Extra weight also increases the risk of breakages where stones are encountered, and the danger of injury to the land through compression, this being very noticeable during the demonstration, especially when the driving wheel on the land traveled within a few inches of the previous furrow. Besides this, a heavy tractor is at a distinct disadvantage for the other and lighter forms of cultivation, such as grubbing, cultivating, seeding, and harrowing, and also for harvesting, especially where the land is sown out with grass seeds.

The light tractor is quite suitable, not only for plowing, but for these other farming operations, and therefore embraces all the usual requirements of a farm tractor, including the driving of a threshing-mill and other farm machinery. It should be kept in view that for heavy stationary work proper anchorage must be provided. The only class of work for which the light tractor does not appear to be suited is road haulage. For road haulage weight is a necessity, as spuds cannot be used to give the necessary gripping power.

This leads the committee to the conclusion that field work and road work are more or less incompatible, and that a light tractor, such as is suitable for land work, is not so useful for road haulage. In addition, for road work, a tractor should be sprung to minimize the vibration, while for field work springs are undesirable, and only entail extra weight.

The committee have come to the conclusion that, to suit conditions in Scotland, an efficient land tractor need not exceed 3360 lb. in weight. In point of fact, several of the tractors which did excellent work at the demonstration were well within that weight.

Horsepower

While, at the demonstration, the machines were shown in the hands of experts, it is generally recognized that under ordinary farm conditions the driver of the tractor may not be able to obtain the maximum output of power, and that for this reason a substantial reserve of power is highly desirable. It must be kept in view that under unfavorable weather conditions considerable waste of power will occur through the softness of the ground and extra friction due to the clogging of the wheels and moving parts with mud, stubble, and manure.

For these reasons the committee is of opinion that for general farm work a tractor should have ample engine power, and they consider that to give the necessary margin of safety 20 B.hp. is the minimum.

In arriving at this conclusion they have in view that the tractor should be capable of hauling a plow taking two full furrows under the worst conditions, and three furrows under favorable conditions, and should also be capable of driving a 4 ft. 6 in. threshing mill.

As stated above, five tractors, embodying a caterpillar track arrangement, were shown.

While this arrangement undoubtedly distributes the actual dead weight, and thus reduces the intensity of pressure on the land, it appears certain that there must be excessive wear and tear on the creeper.

As far as the committee was able to observe, the creeper machine has not been shown to have any advantage in gripping power over the best type of wheel machine, and when it has to encounter a stiff gradient on greasy land it is very liable to slip.

Spikes, Bars and Spuds

The various devices used for giving the wheels the necessary grip of the land may be classified into three groups:

1. Spikes—either round or square in sections.
2. Bars—varying in length and in the angle at which they are placed on the rim of the wheel.
3. Spuds—mostly rectangular in section, and about 3 in. or 4 in. in width.

With regard to spikes, the committee is of opinion that on soft land these do not give sufficient gripping power, and they are also liable to bend or break. Bars, on the other hand, are open to the serious objection that when their width approaches the width of the furrow they cut the turf into sections, and thus seriously interfere with the proper turning of the furrow. Where very long bars are used this drawback is particularly noticeable, and the effect is greatly to impair the quality of the work done. On the whole a stout spud 3 in. to 4 in. in width and from 4 in. to 5 in. in length appears to be the most satisfactory, especially when these spuds are so arranged, in relation to the circumference of the wheel, that the full gripping power of one spud, or its equivalent, is always in operation.

Accessibility and Protection

The committee noted that considerable attention had been given to rendering the vital parts of the machinery more accessible, and also to providing protection from the effects of bad weather. It should be kept in view that tractors require to be left in the fields, where they are exposed to the weather and to the danger of being tampered with by the public, especially in populous districts, and makers should therefore aim at the provision of complete protection. It would also be an advantage to provide some protection for the driver.

Brakes Are Needed

It is desirable, especially for transport purposes, that all tractors should be provided with adequate brakes.

Reliability and Durability

In a demonstration such as the present little opportunity is afforded of forming any definite opinion as to reliability and wearing qualities of the machines. The fact that only one tractor of those which started failed to complete the six days' work seems to indicate that a fair degree of reliability has been obtained, especially considering the amount of shifting and railway transport which the machines had to undergo. In this connection it should be kept in view that the demonstration was a fairly severe test. At the demonstrations there were few machines which did not encounter earth-fast stones on some part of the ground, and that without incurring any serious injury. At the second demonstration the weather was of the severest kind, and the ground was consequently in a very bad state. At the third test a feature of the trials was the gradient on the stubble fields, which was as steep as 1 in 5.2 for short distances in one or two places, and a considerable part of which averaged 1 in 8 or 9. These gradients were successfully negotiated by several of the tractors, even although the ground was in a soft condition.

Two defects may be mentioned as tending to impair durability. These are the exposed gear drives on some of the wheel tractors, which fill with mud and grit, and the already mentioned excessive wear associated with the caterpillar arrangement.

Spring and Other Connections

The committee observed that many makers now recognize the necessity of making some provision for minimizing the

effect on the plow of striking an earth-fast stone. This took the form, in most cases, of a device embodying a wooden peg, which shears on being subjected to undue tension, thus carrying out the principle of the weakest link. This appears to be a somewhat crude arrangement, particularly as it fails to act as an absorber of minor shocks. The committee is of opinion that the drawbar should be provided with some spring appliance, which would relieve the strain on the plow in the case of encountering minor obstacles. With this might be incorporated a release device, which would completely detach the plow under the strain of a heavy shock. The committee suggests that this attachment should be an integral part of the tractor, and not merely a casual device inserted in the draught connections.

It was also observed that while sufficient provision was made for alteration, in a horizontal direction, of the point of attachment of the plow to the tractor, in few cases was provision made for shifting this point in the vertical direction. This is of importance, as for different implements different heights of attachment are required, and even for plowing it was observed that, in some cases, the point of attachment was too low, and there was no means of raising it.

Best Speeds

On the whole, the speeds provided by the makers of the various tractors appeared to be suitable. Most were provided with at least two speeds forward and a reverse. For consistent good work in plowing, any speed exceeding 2½ or 3 miles an hour is excessive. This would also apply to mowing and reaping. For spring cultivation a higher speed is desirable. The committee therefore suggests that speeds of 2½ and 4 miles per hour should meet the requirements of a tractor for use on the land.

The Fuel Situation

It is to be regretted that it was found impossible to carry out any test of fuel consumption in connection with the demonstration. As the question of fuel consumption is of great importance, it should be explained why this was not done. There are two ways in which fuel consumption may be measured:

1. By emptying the tank of the tractor, filling in a definite amount of fuel and noting the work accomplished on that amount.

2. By completely filling the tank, and, after a definite amount of work has been accomplished, refilling and noting the amount of fuel required to refill, which will give the measure of the amount consumed. Both of these plans presented serious difficulties. In the case of the first there was the difficulty that many of the tractor tanks could not be completely emptied. In that of the second the amount of fuel required to fill completely all the tanks, some of which had a capacity of 20 or 30 gal., was such that, under present conditions of fuel supply, it could not be undertaken. In addition to these, there was the difficulty at this time of providing a sufficient number of trained observers to accompany each machine throughout the duration of the test.

Other factors which would tend to render such a test unreliable were the variations in the character of the soil and in the type of plow used, together with the fact that the duration of the demonstration was not sufficiently long to provide time for a reliable consumption test.

The committee formed the opinion that the carbureters on many of the tractors were not capable of thoroughly and completely vaporizing kerosene, and that consequently the combustion in many cases was defective, and the haulage power of the tractor seriously impaired. It may be found, when normal conditions return, more satisfactory to use gasoline rather than kerosene, as being more efficient, even although the price be somewhat higher.

Plow Defects

While some of the plows did excellent work, speaking generally, the work of the plows was much less satisfactory than the work of the tractors. Where a plow expert was in attendance, the plows were soon adjusted to suit the land conditions; but in most cases the man in charge of the tractor, not being a plow expert, was content to devote his attention to the tractor, with the result that the work done was far from satisfactory. Many of the plows, and especially those of foreign construction, were unsuited to perform the work as required in this country. The lack of means of adjustment to varying widths, so as to suit the depths and the class of work, was a conspicuous defect. The furrow slice turned by some of the plows was too wide for work on lea, and perhaps too wide also for early stubble plowing on stiff clay soils. Makers should note that merely turning over the land will not suit Scottish conditions for autumn and winter plowing.

It was further noted that many of the plows which did good work on stubble did unsatisfactory work on lea. If the same plow is to be used for both lea and stubble, it must be made adjustable as regards width of furrow from, say, 8 in. to 12 in.

It may, however, be found more advantageous to have two plows, and that for the following reasons:

1. The provision of means of adjustment may be found to affect the rigidity of the plow, while only providing to a limited extent for the double operation; and

2. The power-drawn plow, being an important farm implement, its breakdown is a serious inconvenience, and therefore it is desirable to have an extra plow in case of emergency.

Many Automatic Lift Plows

For plowing lea, with rough grass on the surface, the plow should be fitted with a disk coulter and skimmer to cut and turn in the grass.

Many of the plows were fitted with automatic lifts, which had the effect of making the tractor and plow a one-man outfit. This is a matter of prime importance, and demands the attention of all plow-makers.

One defect of the automatic lift as seen in operation—where the raising mechanism is operated from the plow wheels, and therefore depends on the forward motion of the plow—is that a plow cannot be lifted while the machine is stationary. That defect is overcome by the power-lift shown on one of the tractors, where the plow is lifted bodily out of the ground by a crane-like mechanism operated direct from the engine.

Another defect noted in some of the plows of foreign make was the absence of any device for regulating the width of the leading furrow, with the result that the position of the tractor affected the size of this furrow, and consequently, where steering of the tractor was not carried out with care and precision, the size of the leading furrow varied to such an extent as completely to spoil the appearance of the plowing. Tractors which had the guidance of one or more wheels in the furrow had an advantage in this connection. Plows with a guide-wheel in the furrow entirely overcome the difficulty, as the width of the leading furrow can be regulated to the same size as the following furrows.

Two suggestions with regard to tractor plows occur to the committee:

1. If the last unit of the plow could be made so that it could be thrown out of action by being raised by means of a lever or otherwise, it would give the option of plowing, say, two furrows on an up gradient and three on a down.

2. The introduction of a one-way plow would obviate the necessity of having feerings and finishes, most of which, under present circumstances, must be performed by horses.

Handling and Turning

At the demonstration all the machines were cleverly handled. The demonstrators were, of course, experts, but it did not appear that the management of the tractors presented any great difficulty to an intelligent man. There also did not appear to be any danger of personal injury associated with their use, provided reasonable care is taken.

The single unit machines had the advantage that the implement operated was directly under the observation of the driver; and the principle is worthy of commendation, especially having regard to its usefulness in other farming operations.

Ample headlands, measuring 12 yards in width, were provided for turning. Some of the larger outfits took the whole

(*Continued on page* 32)

Special Spark Plugs Needed for Airplane Engines

1 Usual Insulating Materials Seldom Withstand Heat
2 Electrode Must Be Specially Cooled
3 Oil Must Not Reach Insulation or Must Be Burned
4 Plug Must Have Good Mechanical Strength

THE writer of this article has been engaged in spark-plug investigation for one of the allied governments. His experience is exceptional, and the ideas in the following are based on much practical work in conjunction with spark-plug testing.—Editor

THE question of producing spark plugs of a quality satisfactory for the severe conditions to which these are subject on the modern highly developed aviation engine, is getting more imperative as the engine development progresses.

In spite of the response from manufacturers in this country and abroad and in spite of the large amount of development work that has been made, indications seem to prove that the spark-plug development has fallen behind rather than followed the engines.

The problem is unfortunately not solved by producing a spark plug that is satisfactory for all engines in production to-day, as a new engine development may come along at any time which may call for still higher qualities in the spark plugs. The fact that the engine must be constructed first, before the spark-plug requirements can be studied, is the natural cause for the lag in the spark-plug development. As, however, the speed of development and progress is accelerating for every day that goes, the lag in the spark-plug development is felt more keenly and the necessity of following up with this cannot be sufficiently emphasized. The deciding factors which determine the construction of the spark plug are heat, oil conditions and gas tightness, in addition to which comes insulation qualities under heat of the insulating material used.

Why the Service Is Severe

It is not always evident to the layman why the service of the spark plugs on aviation engines is so much more severe than on automobile engines. Nevertheless, there is to-day not a single automobile spark plug in use in the air service which has not undergone considerable changes in material or design. The difference can, however, easily be comprehended when a rough comparison is made.

The average automobile spark plug has proved entirely satisfactory on the average automobile and the life of a well-made spark plug has been practically unlimited. The average speed of a touring car is probably not over twenty miles an hour and the corresponding engine speed averages approximately 1000 r.p.m. This is furthermore intermittent service. A touring car will hardly ever travel at the rate of 40 m.p.h. for a period of over four or five minutes without slowing down, passing other vehicles, curves, etc. On the aviation engines the spark plugs are called upon to operate hour after hour at an engine speed of 1800 to 2200 r.p.m., without a minute's let-up—without a drop of as much as 20-30 revolutions. The effect of this continuous high speed can hardly be understood if it has not been seen in practice.

However, experience has proven that a drop of 10-20 per cent in engine speed for a few minutes will allow the spark plugs to overcome some of the fatigue to which they are exposed and prolong their life for a time period many times as long as the period of rest that was given them. On engines where the spark plugs are subject to severe conditions, their life may be a few hours on continuous run under full load, while it may be ten times as long if the engine is run at 75-80 per cent full power. From this it is better possible to understand the excellent service obtained in automobile practise from a number of different makes of spark plugs. Even in racing practise we find that the least retardation while turning the curves of the track is sufficient to offer the spark plugs a period of rest that materially increases the length of their life. This is only one factor in the spark-plug service, which, however, in itself proves the distinctive difference in the operating conditions. Other factors such as compression and heat must also be taken into consideration.

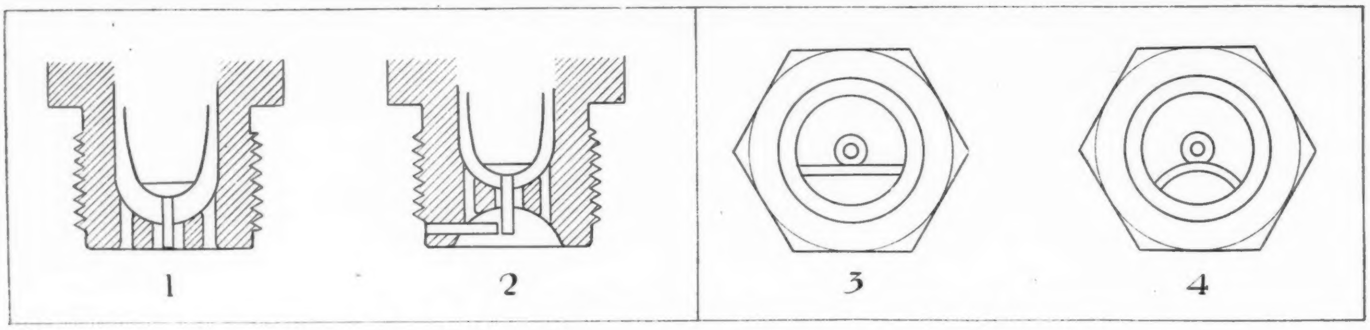
Compression Conditions Differ

The compression on the average car is 70-80 lb. per sq. in. when the engine is new, but in most cases this falls rapidly when the engine is slightly worn and 50-60 lb. is undoubtedly nearer the average of cars in actual use. The compression of the aviation engine has steadily been increased during the past few years and goes now as high as 120-130 lb., and it must be kept in mind that this compression is practically maintained throughout the life of the engine, as this is ordinarily overhauled for every 50 hours of actual service, and all worn parts replaced.

The local heat in the insulation body of aviation spark plugs is high, due to the increased number of explosions and the high mean effective pressure in connection with the poor heat-conducting qualities of most of the insulation materials which are adaptable for spark-plug construction.

In studying the construction of the spark plugs we find that there is a number of different conditions that must be met, and which again largely depend on the material used for the insulation bodies. The main requirements will be stated first followed by a brief discussion of the ways and means of meeting these.

The requirements are:



Some of the different constructions commonly used in airplane engine spark plugs

(1) Gas tightness.
(2) Mechanical strength.
(3) Self-cleaning qualities.
(4) Minimum electrical leakage.
(5) Temperature resistance.
(6) Absence of preignition.

Perfect gas tightness is very difficult to obtain, on account of the different temperatures to which a spark plug is subject; temperatures which are not uniform throughout the various parts of the plug. Where different parts are assembled by means of mechanical joints such as compression nuts or spinning operations, it is evident that different temperatures cause different expansion of the various parts and tend to produce gas leaks. To overcome this it is necessary that the joints are compressed to such a degree that there is danger of setting up stresses on the insulating body, which may prove fatal to this and cause mechanical breakdown.

Obtaining a Gas-Tight Joint

A more satisfactory way of producing a gas-tight plug is to use an insulation body that can be brought into chemical connection with the metal parts. Such has been done by "welding" a glass body into the steel shell. A joint of this kind will stay tight under all temperatures encountered in actual service. The success of such a construction depends, however, entirely upon the characteristics of the glass composition. The spark plug must, unless the melting temperature of the glass is high, be designed so that the glass will remain very cool under operating conditions. This, however, allows oil and carbon to collect on the surface of the glass without burning it off and thus destroys the self-cleaning properties of the plug.

The cemented joint, which appears around the center electrode in the conventional design of porcelain plugs must be made with great care. Some cements that have been used successfully for a number of years in automobile practise have proved to soften and melt when exposed to the high temperatures of an aviation engine. Others seem to loose their body and drop out as a powder, thereby exposing cavities inside of the porcelain. The pressure in these cavities will increase with every compression and explosion stroke, and will again decrease with the intake stroke, thus causing hot gases to flow back and forth and produce excessive local heating of the porcelain. This will result in an uneven expansion and crack the porcelain in a very short time. Local heating, caused by leakage or cavities, is the main reason for the strict requirement of absolute gas tightness, as the effect is the same if a leak occurs at any place around the gasket seat of the insulation body. The loss in compression, due to a small leak in the spark plugs, is negligible and not in any way to be compared to the importance of the effect on the insulation body.

Mechanical strength of the insulation body plays an important part, as a great mechanical strength will allow a high pressure to be used in the joints and consequently resulting in a tighter spark plug. The location of the spark plugs on the engine is oftentimes such that mounting and dismantling is difficult and special wrenches necessary. The spark plugs are, therefore, subject to more or less severe treatment and satisfactory mechanical strength is required.

Plugs Can Be Self-Cleaning

Some reference has been made to the self-cleaning properties above, where mentioning was made of glass as insulation body. There are two ways of obtaining satisfactory performance. One is to construct the spark plug in such a way that the insulation body is protected from oil and carbon. The other is to expose the insulation body to the heat of the explosion to such a degree that any oil and carbon that may collect on the surface will burn off. Which of the two constructions to select depends entirely on the heat-resisting qualities of the insulation body used. The two materials used most successfully at the present time are mica and porcelain. A mica spark plug must always be constructed so as to protect the mica core from heat, oil and carbon, as oil will penetrate between the layers of mica no matter how tightly these are compressed, and in time form a conductive carbon deposit.

A great variety of different constructions have been brought out, most of which have a closed bottom at the lower end of the shell with a small central hole through which the center electrode extends. For a construction of this kind special precautions must be taken to avoid preignition, as will be mentioned below. The sparks jump from the center electrode to the edges of the hole in the bottom which forms a ring-shaped electrode. This construction will cause somewhat harder starting of the engine and poor throttling ability at very low speeds due to the fact that the sparks are divided over a ring-shaped area and will separate in a number of tiny streaks rather than condense into one strong spark. The sparks are, furthermore, not exposed to the fresh gases in such a favorable way as when jumping between two pointed electrodes extended free of the shell.

A better construction is secured by providing a recess inside of the shell that will act as a baffle plate instead of closing the bottom. This baffle must be located slightly inside of the shell and the center electrode extend through it to the lower part of the shell, where a connectional ground wire electrode is used.

A few different constructions commonly used are demonstrated in Figs. 1, 2, 3, 4. The semi-circular bend of the ground wire in Fig. 1 is claimed to minimize warpage of the wire and change in the size of the spark gap when the wire becomes hot and expands. Other types of closed bottom spark plugs use a disk-shaped center electrode closing up practically all the space between the wall of

the shell, leaving only a gap of 0.02 in., which acts as the spark-plug gap. This type offers the same inherent disadvantage in starting and throttling as the type shown in Fig. 1.

With porcelain as insulator, the open-end plug has proved most successful hitherto. The quality of the various porcelains has been much improved, and it is possible to use a plug where the lower end of the porcelain extends almost to the lower end of the shell and is exposed directly to the heat of the flame. The temperature of the lower end of the porcelain becomes so high that oil and carbon are immediately burned off and the surface remains clean.

Great Strength Is Needed

It was necessary to develop porcelain compositions of great mechanical strength at high temperatures to obtain this, and, furthermore, to compound the glaze so that the expansion coefficient of both materials is practically alike. Difference in expansion coefficient will cause blistering of the glaze after a few hours run of the engine. This has especially been found where materials of the soapstone variety have been used as insulators and has prevented the further use of these materials, which in other ways offers several advantages and which has proved extremely successful for automobile practice. The closed-end porcelain plug has been used to some extent, as it offers certain advantages which will be indicated later.

All insulation materials used in spark-plug construction decrease in electrical resistance with increasing temperature. While the temperature at which this commences is far above the temperature reached in the average automobile spark plug, the temperature of the aviation engines approaches so much to the critical point of insulation material that improvement and development was necessary. A great variation in the different porcelain compositions existed and a thorough research of a large number of compositions resulted in a far better grade of porcelain being used to-day than a year ago.

Insulation Resistance Important

A material decrease in insulation resistance will cause an electrical leakage from the center electrode to the shell and result at first in a weakening of the spark which under unfavorable carburetion and distribution of the charge may cause failure in ignition. This is so much more the case with aviation engines as these are commonly of the multicylinder types, which puts a greater demand on the ignition apparatus on account of the higher speed and the greater number of sparks required. It becomes, therefore, of vital importance to preserve every atom of heat and energy in the ignition sparks.

So far, the largest amount of difficulties encountered has undoubtedly been due to breakage of the porcelain on account of heat and uneven expansion. The breakage occurs on the lower part of the porcelain which extends free inside of the shell. The causes are various. The uneven heat of the porcelain will set up internal stresses, the difference in expansion between the metal of the center electrode and the porcelain will, if too large, cause tension between these two parts sufficient to crack the unsupported porcelain; the continuous impact of the explosions and the great change in temperature when the engine is started or stopped tends to shatter the structure and to destroy the mechanical strength of the porcelain.

A breaking or chipping of the porcelain inside of the spark-plug shell is liable to cause serious damage to the engine itself, in addition to the disturbance in the performance, as porcelain pieces may be wedged in between the piston and the cylinder wall and score the latter. To avoid this, several constructions of porcelain plugs with closed bottom, similar as shown for mica plugs in Fig. 1, have been brought out. The porcelain chips will be caught by the bottom wall and prevented from entering into the cylinder. It has, however, been found rather difficult with this construction to maintain a clean porcelain and prevent fouling, although further and more satisfactory development of this design is to be hoped for.

Closed Ends Cause Preignition

As mentioned above, the closed-end plug is liable to cause preignition. This is caused by the hot gases passing up and down through the space around the center electrode into the inner chamber. In order to reduce this effect it is necessary to provide additional holes in the bottom so as to divert part of the hot gases through these holes and away from the center electrode. The center electrode is the member that causes the preignition, as it is the hardest part to cool, due to the fact that it extends through the insulation body, which also acts as a perfect heat insulator and tends to retain the heat in the electrode. The only point of the electrode that is exposed to any cooling effect is the upper end that extends above the porcelain, and this end is in many cases covered with a brass cap which the electrode merely touches lightly, a joint that has practically no value as a heat-carrying point.

The diameter of the center electrode should be as large as it is possible to use without getting into difficulties from expansion and the upper end should form a good contact with the brass cap, which in turn may be provided with cooling fins. The lower end, which extends beyond the porcelain, must be as short as possible and eventually of a smaller diameter than the rest of the electrode, so that it will collect as little heat as possible. The ground electrode is not very likely to cause preignition unless it is excessively long. The material for the center electrode should be as good a heat conductor as possible.

A good practise has been to make the lower part of nickel alloy wire and the upper part of copper. In this case precautions must be taken to see that the joint between the two wires is such as to form a good heat carrier.

Different Mica Constructions

In a mica plug two different constructions are prevalent; both are giving about the same result in service. In the first construction the mica layers are mounted horizontally as washers around the center electrode. These washers are held at the bottom by means of a flange on the electrode and at the top by a nut or by riveting a small disk to the electrode. The pressure which the nut or the disk exerts upon the mica washers must be great so as to hold them tightly together and form a compact core.

It is necessary, therefore, that the electrode possesses sufficient mechanical strength to withstand the reaction of these forces, and it must be especially borne in mind that this electrode is exposed to heat which will cause expansion and reduce the pressure upon the mica washers. A material should, therefore, be chosen which has a small coefficient of expansion, great tensile strength and good heat-conducting qualties. The electrode should, furthermore, be provided with cooling fins on the upper end to reduce the temperature throughout its length.

For the other construction of mica plugs, the mica is wound axially around the center electrode. While in this case the expansion of the center electrode has no harmful effect on the insulation core, special provisions must be made so as to protect the lower end of the mica from splitting, and the core should, furthermore, be subjected

to some sort of an impregnation that will prevent leakage taking place between the mica layers.

In order to resume the various requirements as stated above, it may be said that a satisfactory spark plug must fulfill the following conditions: All materials used for the main parts of a spark plug shall have a low coefficient of expansion. This coefficient shall not be the same for all parts but invertly proportional to their heat-conducting quality. For instance, the expansion coefficient of the center electrode shall be lower than that of the porcelain, due to the higher temperature of the electrode. In cases where it is impossible to fulfill this condition it will be necessary to make such provisions as will allow the expansion of a certain part to take place without causing any disturbing effect on other parts of the spark plug.

The center electrode must be well cooled, preferably with fins on the upper end, and only a small part of the electrode shall be exposed to the heat of the engine, *i.e.*, the extension beyond the lower end of the insulation core shall be very short and of small diameter, sufficient only to prevent warpage under heat. All points in the center electrode should be welded or of a similar construction that will insure heat conductivity. The ground electrode must be short and rigidly held, and preferably consist of a single-point electrode. The lower end of the shell must be given such a shape as will protect the insulation body from oil and carbon unless the material used is of sufficient heat-resisting quality to withstand the heat of the explosion and permit the carbon to be burned off. If cement is used this must not soften or deteriorate at temperatures somewhat above service temperature.

Scotland Favors Light Farm Tractors

(*Continued from page* 28)

of this space, but, on the other hand, many others, including the single-unit machines, were able to turn in half this space, or even less. These smaller outfits also occupied less time in turning, being in many cases able to go out, turn, and re-enter without any stoppage or slackening of speed. Some of the larger outfits required a considerable amount of maneuvering before the tractor and plow could be got into position to commence the next furrow, especially when called upon to make a close turning. The furrow ends were in some cases irregular, but this may have been due to lack of proper care on the part of the driver.

Best Price

The question of price is a difficult one under the present abnormal conditions. Makers should, however, aim at putting a tractor on the market at a price not exceeding $1,500.

As at the demonstration at Stirling two years ago, it is again matter for regret that British makers of agricultural tractors were not more adequately represented. The same causes which operated against their taking fuller part then are still, unfortunately, in operation. Only about one-fourth of the machines entered were of British construction.

Demonstration Valuable

Regarding the demonstration as a whole, the committee feels that it has served a useful purpose in providing an opportunity for all interested in agriculture to form an estimate of the capabilities of the machines exhibited, and it is hoped that the effect may be to make mechanical cultivation more popular in Scotland than it has been hitherto. In this way the interests of increased food production may be served. At the same time it is obvious that such a demonstration must be of great value to manufacturers in demonstrating the points in which their machines are defective and the directions in which improvement should be sought.

The committee is glad to be able to record that the result of the demonstration has been to show that extraordinary progress has been made within the past two years, and for this advance great credit is due to agricultural engineers and manufacturers.

Condensed Tractor Specifications

BELOW is given the blank for condensed tractor specifications as adopted at the recent Minneapolis meeting of the Tractor Division, S. A. E. Standards Committee. It is intended for use in tractor catalogs.

1. Firm name and address..............................
2. Tractor trade name or model number..................
3. Drawbar hp. ....
   (*Old trade rating and S. A. E. rating.*)
4. Belt hp. ....
   (*Old trade rating and S. A. E. rating.*)
5. Motor make—bore and stroke.........................
6. Number of cylinders and cycle.......................
7. Normal speed, r.p.m...................................
8. Lubrication system or type...........................
9. Ignition ....
10. Carbureter and fuel system...........................
11. Cooling system, type..................................
12. Belt pulley diameter, face and r.p.m..................
13. Transmission type or make...........................
14. Number speeds forward...............................
15. Rate m.p.h.: Low....... Plowing....... High.......
    (*At normal engine speed.*)
16. Number of wheels and arrangement..................
17. Number, diameter and face of drive wheels...........
    (*If track type give number, track, length and width.*)
18. Number, diameter and width of non-drive wheels......
19. Frame construction ....
20. Wheelbase and tread..................................
21. Total width overall.......................................
22. Total length overall
23. Turning radius ....
    (*One-half diameter largest track circle.*)
24. Total weight, less fuel, water, oil and lugs.............
25. Shipping weight, including standard equipment and stays ....

A New Aluminum Solder

A SOLDER for aluminum is being marketed my the Sterling Aluminum Solder Company, Inc., Brooklyn, N. Y. Repairs of broken aluminum parts by the use of this solder are said to be cheaper and quicker than repairs by other methods. One of the special advantages of the solder is that it requires only a low temperature (300-350 deg. Fahr.) to melt it, and that no flux or acids of any kind are required. It is applied with the aid of the gasoline torch. The surfaces to be soldered are first thoroughly cleaned with a steel brush; then a thin coating of the solder is applied, which is also brushed with the steel brush, and finally another coat is applied for the purpose of joining the parts. It is claimed that this solder protects the metallic aluminum against oxidation. Greater strength is claimed for the solder than that of the aluminum itself. Owing to the low temperature used in melting the solder there is no danger of warping or distorting the parts, and the aluminum will not be deteriorated by excessive heat. One of the most important automobile repairs to which this solder has been applied is that of a broken crankcase.

Truck Efficiency Graphically Shown

1—Need for Rapid Loading Not Realized
2—Short Hauls Suit Heavy Truck Service
3—Saving Minutes Adds Miles, Cuts Costs
4—Charts Eliminate Need for Calculation

By Francis W. Davis
Assistant Chief Engineer, Motor Trucks, Pierce-Arrow Motor Car Co.

THE problem of analyzing motor-truck transportation is fundamentally different from other so-called modes of transportation in that we have to do with a factor of far-reaching importance in determining the capacity or ability of motor trucks to perform a given amount of work. This factor is the so-called loading and unloading time.

At first sight, it appears to be of little importance, as when considering horse team haulage very little attention is given to it. This is quite natural when we consider the fact that a team of horses can only cover a relatively small mileage in a day, and their average speed is of sufficient magnitude to cover this limiting daily mileage in a few hours, consequently the necessity for quick loading and unloading can be almost disregarded when dealing with team haulage.

With a motor truck we are face to face with entirely changed conditions. The capacity of the truck is only limited by the number of hours it is in operation, and by operation we mean actual *running* time and not merely the time the truck is in commission.

It is true that the facts as outlined above are instinctively understood by truck operators, and more and more time and effort is put into devising ways and means for reducing the so-called loading and unloading time of motor trucks. We hear of overhead hoppers, demountable bodies, loading cranes, winches, mechanical dump bodies, and innumerable other devices for saving time. This is all done for a very definite purpose, and it is strange that up till very recently little effort has been given to the important study of the absolute necessity for reducing this loading and unloading time and showing the relative amount of work that can be produced where efficient loading and unloading appliances are considered as compared with old out-of-date horse methods.

In approaching a problem to determine whether motor trucks can be used to advantage in a given transportation problem or to study means for increasing the efficiency of a motor-truck installation, it is customary to carefully investigate the loading and unloading conditions, nature, and distance of routes traveled, and other facts of more or less importance in order to draw up a report covering the capacity of a given truck under certain conditions.

In addition to this, it is also customary to investigate the problem from a cost standpoint to determine the fixed charges per day and so-called operating expense per day, the latter usually worked down to a cost-per-mile basis.

Calculating Truck's Working Capacity

In calculating the working capacity of a truck, we determine the round-trip distance of the haul, which we will call D. The loading plus the unloading time for each trip we will designate by L. Then, with an assumed ten-hour working day, the one remaining factor which we are in need of is the operating speed in miles per hour which we expect the truck to maintain during its period of operation.

Experience indicates that while a truck is in motion it averages approximately 75 per cent of the full governed

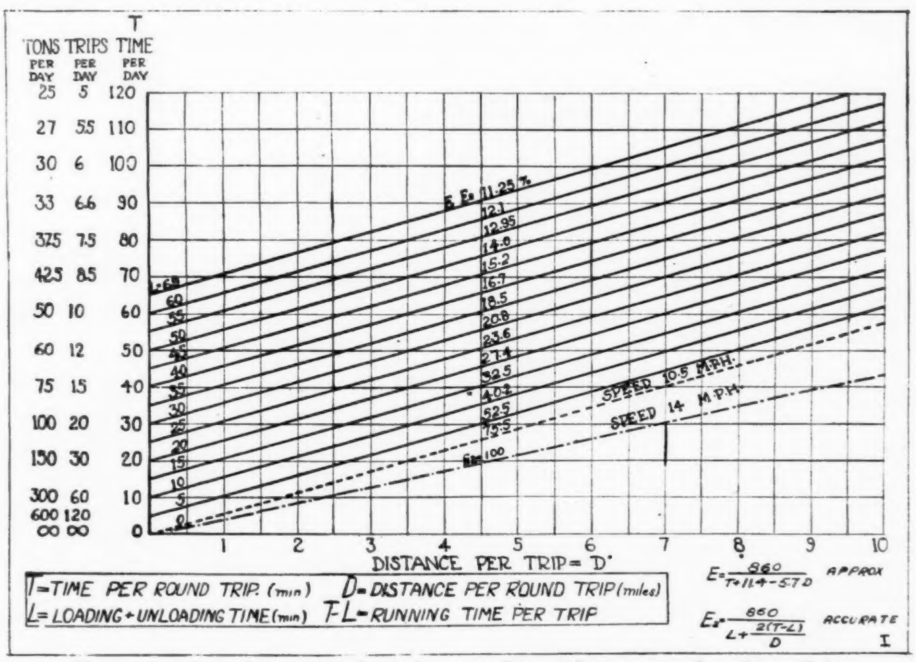
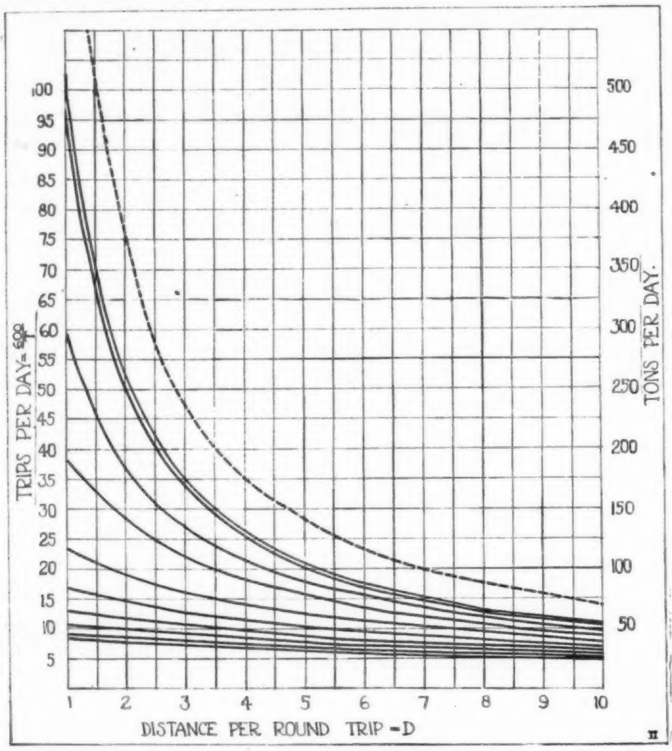


Chart showing time per trip, trips per day and tons per day for a 5-ton truck of 10.5 m.p.h. running speed, different round trip lengths and loading times



Tons per day and trips per day for different round-trip distances

speed. The loss of 25 per cent is occasioned through traffic delays, varied road conditions, and other factors which are quite beyond control. With the 5-ton truck governed to 14 m.p.h., the 75 per cent figure amounts to an average rate of $10\frac{1}{2}$ m.p.h.; therefore, while in operation we say the 5-ton truck will cover a mile in 5.7 minutes' running time.

With this information at hand, we are in position to proceed further, and in order determine the time per round trip, which we will call T, it is necessary to multiply the distance D by 5.7 and add this figure to the loading and unloading time L per trip.

To determine the number of trips per day, it is then necessary to divide 600 (the number of minutes in a day) by the time per round trip T in minutes.

The above is an extremely simple operation, and yet it is the basis for estimating truck work, and is invaluable in arriving at a working basis for considering the cost figures.

The following symbols will be of assistance in following this analysis:

D—Distance per round trip in miles.
L—Loading plus unloading time per trip in minutes.
R—Running time per round trip in minutes.
T—Total time per round trip in minutes.
M—Maximum speed in miles per hour.
75 per cent of M = running speed.

$$T = L + R$$

$$R = \frac{60\ D}{0.75\ M}$$

$$T = \left(L + \frac{60\ D}{0.75\ M}\right)$$

M = 14 m.p.h. (for Pierce-Arrow 5-ton truck)

$$T = (L + 5.7\ D)$$

10-hr. working day = 600 minutes.

$$\text{Trips per day} = \frac{600}{T} = \left(\frac{600}{L + 5.7\ D}\right)$$

Truck carries out 5 tons; returns empty

$$\text{Tons per day} = 5 \times (\text{trips per day}) = \left(\frac{3000}{L + 5.7\ D}\right)$$

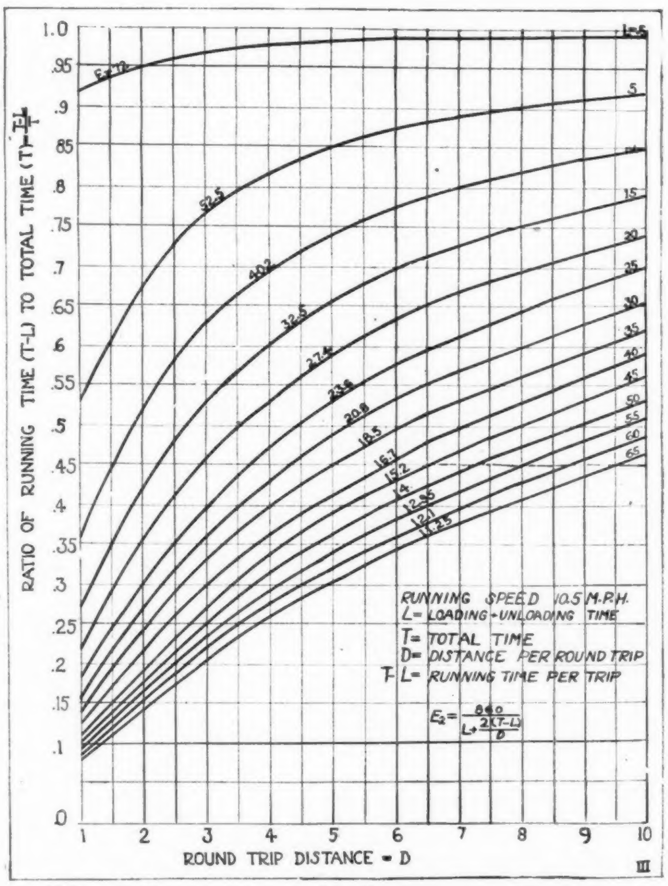
$$\text{Miles per day} = D \times (\text{trips per day}) = \left(\frac{600\ D}{L + 5.7\ D}\right)$$

$$\text{Ratio running time to total time} = \frac{R}{T} = \left(\frac{T - L}{T}\right)$$

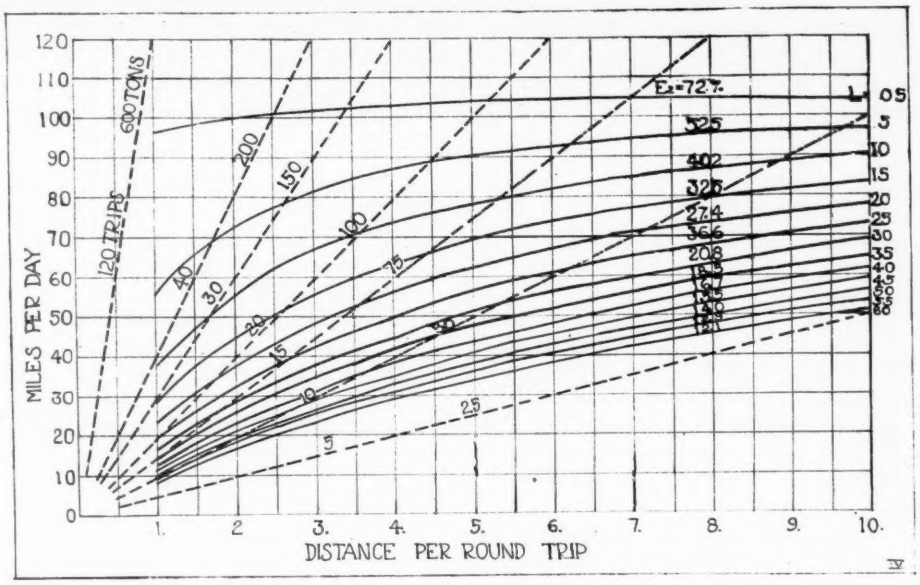
Let us carry this line of thought a little farther. The above method of figuring gives us a rapid and accurate method of determining the capacity of a motor truck under any given conditions. However, very often in discussing the usage of motor trucks with a prospective owner the item of loading and unloading time is not only difficult to estimate but often is subject to considerable revision through the consideration of some simple auxiliary equipment. The prospective owner is usually quick to raise objections against this, due to the cost of the equipment. Then the figures showing the capacity of the truck must be corrected to show its increased capacity due to the addition of this extra equipment.

This process can be repeated a number of times, and if done rapidly and accurately will give the truck owner a good idea of the increased capacity of his equipment due to quick loading and unloading.

With a view to showing this graphically, and in such a way as to admit of instantaneous comparisons, the accompanying charts, with the above facts incorporated, obviate the necessity for actually putting down figures, and permit of comparisons, one truck with another, under varying conditions. The charts also answer in a remarkable manner the old-time fallacy that motor trucks cannot compete with teams in short hauls. The short



Effect of loss of time in loading upon work performed by truck



Effect of time lost in loading and unloading on daily mileage

haul is the "bonanza" of motor-truck haulage where the conditions are right.

Chart 1 is drawn up for the Pierce-Arrow 5-ton truck, on the assumed running speed of 10.5 m.p.h. The distance per round trip D is shown on the base line up to 10 miles. The time per round trip T is shown on the vertical line at the left of the chart, and runs up to 120 minutes. The loading and unloading times are indicated by L, and vary from zero up to 65 minutes per trip. Two other vertical scales are included, namely, the trips per day and tons per day, the tons per day bearing the relation of five times the number of trips per day, inasmuch as we are concerned with a 5-ton truck and assume a load of 5 tons carried out.

The chart is read by:

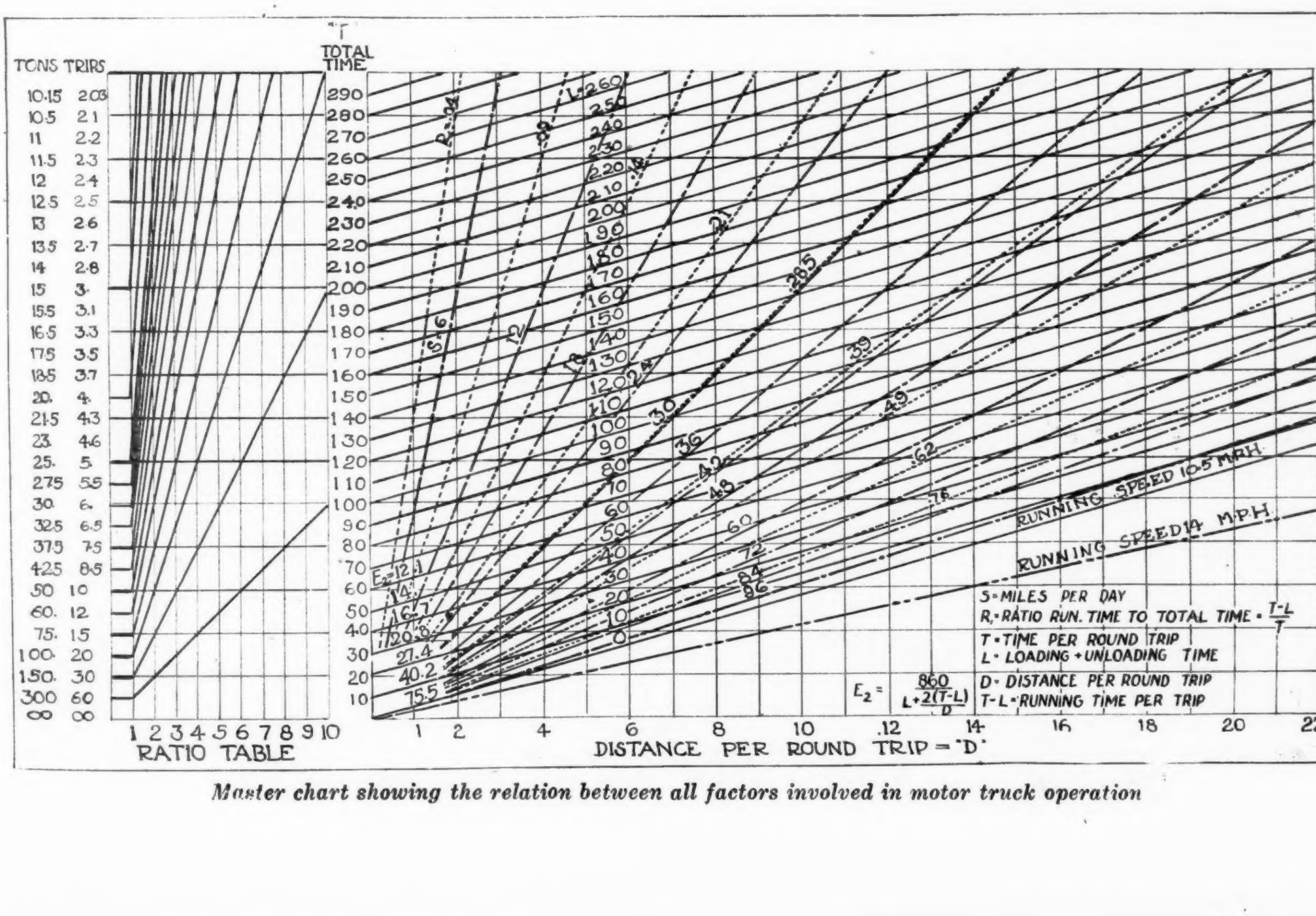
1. *Running out the base line to the distance per round trip.*
2. *Then vertically to the intersection with the L line.*
3. *Then follow horizontally to the left to the intersection with the three vertical scales, giving the time per round trip, trips per day, and the tons per day.*

By using the same distance per round trip, and dropping down to a lower L figure, we arrive at the time per round trip, trips per day, and tons per day with the new loading and unloading condition. This can be done rapidly, and gives surprising results when dealing with reasonably short hauls and small values for L.

The other figures of E and $E2$ represent efficiency figures which the writer has worked out at considerable length, starting from quite different grounds of reasoning, and yet the lines representing values of L are constant efficiency lines, and the formulæ E and $E2$ give equal values for truck efficiency on these lines.

Chart 2 uses the same base line as 1, with altered scale of trips per day and tons per day, so as to show the enormous increase in capacity of the truck when operating on short hauls under efficient conditions of loading and unloading, and it furnishes a graphical proof of the often repeated assertion that quick loading and unloading time is much more essential in short hauls than in long hauls.

This statement is true, and with this chart it is brought out to an astonishing degree. For instance, it shows that in a round-trip haul of one mile, with loading and unloading time L of 60 minutes, the 5-ton truck can make approximately nine trips per day, carrying a total of 45 tons. When reducing L to five minutes per round trip,



Master chart showing the relation between all factors involved in motor truck operation

the truck will make approximately sixty trips per day carrying 300 tons. This represents an increase in capacity of over 600 per cent. Further, if we consider this same haul with a loading and unloading time of ½ minute, which has been reached in certain installations, the truck has a capacity of 96 trips per day of 480 tons. This represents an increase over the first condition of approximately 1000 per cent. These are the facts that must be brought home to the truck user in order for him to get the full benefit of his equipment.

Operating Only One-Fifth of Time

How often do we hear that a truck is on the road only one-fifth of the day? This is the condition under which a great many trucks operate, and also a great many do not equal this figure. Chart 3 gives graphically a picture which shows that when a truck operates under this condition the owner should be indicted for criminal misuse of his equipment. On Chart 3 the point two-tenths of the way up on the left-hand scale—*i.e.*, representing the condition of one-fifth running time—shows that the operator in this case is operating his truck only up to this level. Above that is the region which he knows nothing about, and in which he denies the truck the opportunity of working. The limiting capacity of the truck, of course, is that it may be on the road the *entire time.* Figures of *E*2, given both on Charts 2 and 3, represent constant efficiency lines the same as on Chart 1.

There is another figure of importance, namely, the number of miles per day the truck will cover. Chart 4 is drawn up with the same base line as the other charts, and indicates the miles per day as related to the loading and unloading time, and also the relation of the trips per day and tons carried, as related to the miles per day. This chart again shows that when we reduce the loading and unloading time we increase the capacity of the truck, and on short hauls this increase goes up to an amazing figure.

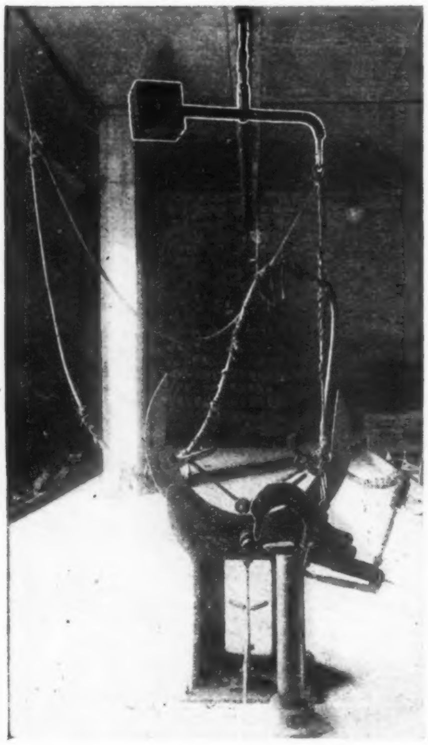
Chart 5 is a master chart of the others shown before, and includes all of the information contained on the foregoing charts. In addition, the base line is extended up to 22 miles and the time per round trip extended up to 300 minutes. The vertical scale for the total time per trip is marked T. A ratio table will be noted at the left end of the chart. This is useful where making comparisons so as to show the ratio of increase in the number of trips per day and tonnage hauled under conditions where quick loading and unloading are considered, as against one where slow loading and unloading are considered.

Determining Increase

The procedure is to locate the number of trips per day on the vertical scale corresponding to the slow-loading figure, and, by tracing out to the diagonal line, reaching down to the greater number of trips, the vertical line from that point to the ratio table indicates the ratio of increase. This is somewhat difficult to explain in wording, yet a short study of the chart will show how easily and quickly it can be done.

The foregoing charts should prove not only of great value in analyzing new transportation problems, but should place in the hands of traffic managers means whereby trucks can be distributed for a given day's work so as to utilize the transportation equipment to the best possible advantage.

Guards for Riveting Frames



Weight used to counterbalance riveting hammers mounted on a standard Palmer-Bee track and trolley

AIR riveters used for riveting frames in automobile shops are often suspended on trolleys or cables, with a counterweight to balance the riveter. The Reo Motor Car Co. had many of the weights become detached and drop down, and this trouble was overcome by putting a yoke on the trolley with a balance weight on one end and only running a cable down. If that breaks the only thing that can come down is the hammer.

In the Packard shops use is made of a stand constructed of pipe fittings. It is adjustable for height and can be clamped into position. This stand has given fairly satisfactory results. One of the men at the Packard plant is working on a drum with a spring control so that when the hose is moved away from the connection it is automatically released. This was found to be the only solution of the problem of getting around the truck frames to rivet them together.

Melting Aluminum Scrap

THE fluxes commonly used in melting aluminum scrap, says *Brass World,* are fluorspar, cryolite, and salt. An excellent way of utilizing such material when a part of the scrap is small and not clean is first to melt a bath of aluminium, using solid material, and to allow it to reach a temperature of approximately 850 deg. C., then add the sweepings, etc., in such quantity that the bath will absorb them without losing its liquidity. The bath is then reheated and more scrap charged, the process of charging and reheating being alternated until the crucible is as full of metal as desired. The metal will most likely be pasty, and a small piece of fused zinc chloride is added and the bath well stirred. The resulting action will free the mixed oxides and the metal will assume its natural fluidity. The crucible should be immediately emptied of aluminium before any reaction can occur between the metallic aluminium and the heated oxide on the one hand and the oxygen and nitrogen of the atmosphere on the other, as such reaction will consume metallic aluminium and greatly reduce the percentage recovered.

Now that aluminum is quoted at about 60 cents per pound the recovery of all scrap with the least possible loss has assumed great importance. The great affinity of the molten metal for the chief constituents of the atmosphere renders the process difficult.

Probable Advances in Motorcycle Design

New Types of Engines That May Come to the Front—Simplification of Equipment —Changes in Frame Construction Likely

IF the next few years should see a great increase in the demand for motorcycles, as is confidently expected, we may hope to see also a great deal of improvement in design, partly to render the machine more serviceable as a conveyance and partly to facilitate its production on a large scale—in other words, to make it a better manufacturing proposition. It is true that the present standard makes of motorcycles are very serviceable machines, but not even the designers themselves would contend that the zenith in engineering development has been approached within measurable distance. A widening market naturally encourages development work, for the greater the prize the greater the stakes that capitalists and engineers are willing to put up.

In regard to engines the situation in the motorcycle field is at present somewhat unsettled. Engines from one to four cylinders are used, though the two cylinder Vee type is distinctly in the lead. The selection of this type must be regarded as a compromise. Having two cylinders it is somewhat smoother running than a single cylinder, and it obviates some of the complication of the four cylinder. What undoubtedly decided the question in favor of this type of engine is the fact that it fits well into the conventional frame. Since the angle of Vee is always considerably less than 90 deg. the engine is not well balanced, and, besides, its explosions are unequally spaced.

From the standpoints of balance and uniform spacing of impulses the best type of engine with only two cylinders is undoubtedly the horizontal opposed type. This engine was successfully used for automobile work for many years. The objection to it is that it is of unwieldy length and very difficult to accommodate on a car. This objection might seem even more potent on a motorcycle, but practically it does not work out that way. The motorcycle industry probably has seen a greater development in England than in any other country and one of the best known English motorcycles, the Douglas, has a double opposed engine.

What may be called the displacement efficiency of the motorcycle engine has been increased to such a degree that for a light machine an engine of very small piston displacement now suffices. On the heavier machines the piston displacement is always between 60 and 61 cu. in., that is, just inside the limit set for racing machines. But for ordinary service over moderately good roads an engine with between 35 and 40 cu. in. piston displacement should deliver all the power required. To keep the length of the engine within bounds a comparatively short stroke would be chosen, say very slightly greater than the bore. A bore of 2¾ in. with a stroke of 3 in., for instance, gives a piston displacement of about 36 cu. in. Such an engine can be built not to exceed 22 in. in length over all, and if the connecting rods are made short and the wristpins located as close to the top end of the pistons as possible—practices which do not conduce to long life of the engine—even this length can be materially cut. There is no difficulty in placing such an engine between the two wheels.

Light weight is certainly a desirable feature, and if it is advantageous to cast the cylinders of large touring cars of aluminum, the same practice applied to motorcycle engines should yield good results. There should be no need for liners of cast iron in an aluminum cylinder of this small size, for it stands to reason that if an aluminum piston in a cast iron cylinder has a satisfactory life, an aluminum cylinder having a cast iron piston working in it should leave little to be desired. In fact, the combination should be almost ideal because the lower coefficient of expansion of the cast iron would be compensated for by the higher temperature of the piston, so that a very slight clearance on the piston would suffice and the piston would be substantially the same fit in the cylinder whether the engine were hot or cold.

Minor advantages of the horizontal opposed engine are that it lowers the center of gravity of the whole machine, rendering it safer, and that it tends to equalize the cooling of the two cylinders.

Certainly one of the least satisfactory features of the present day motorcycle is the free chain drive. As long as the chain is clean and well lubricated it gives good service, but it is impossible to keep it so in regular service. When dirt accumulates upon the chain it soon gets into the numerous pin joints and the chain becomes squeaky, wears and "stretches." On the average motorcycle there is not only one chain for the final drive, but an additional chain for transmitting the engine power to the transmission. Some day no doubt we shall have a fully enclosed and effectively lubricated final drive on motorcycles, the same as we have on automobiles, but just how this is to be accomplished it is not so easy to say—whether by the elimination of the chain or by its enclosure. The problem of a satisfactory chain case is admittedly a very difficult one; if it were not, we should have had more motor trucks fitted with them. Of course, in a motorcycle there is no variation of sprocket centers.

Frames are at present invariably of tubular construction. The tubular section is very good from the standpoint of strength for a given weight. There are two inconveniences connected with the tubular frame, however, which may possibly induce motorcycle engineers some time in the future to follow the lead of automobile engineers and adopt pressed steel frames. The first is that tubular frames must be joined up by brazing, and the high heat required in this process tends to impair the quality of the steel in the tubes and in any case makes heat treatment of the frame impossible. The second inconvenience is that it is difficult to secure anything directly to the frame without the use of rather heavy brackets. From a tubular to a pressed steel frame would, of course, be a very radical change and would involve a complete redesign of the motorcycle.

There is a well founded impression that motorcycles are at present cluttered up with too many fitments that are not strictly necessary. A commendable step looking toward the simplification of the machines was made when, at a meeting of representative manufacturers, it was recommended to the Government that emergency brakes be left off the machines for the army.

Studebaker Has an Entirely New Line

Two Sixes and a Four, with Engines of High Speed Type —Transmissions Separate and Located Amidships— Hotchkiss Drive and Fabric Universals Among Features

THREE entirely new cars will be marketed by the Studebaker Corp. for 1918. This marks an entire revision of the Studebaker line which consisted of two cars last year. The new cars are a large six on a 126-in. wheelbase, a smaller six on a 119-in. wheelbase and a four having a 112-in. wheelbase. On the larger six there is a seven-passenger touring body; on the smaller six a six-passenger, a four-passenger and a two-passenger body are offered, and on the four a five-passenger and a two-passenger.

The entire line is replete with engineering features new in Studebaker practice. Probably the most significant change is the abandonment of the rear axle gearbox which has distinguished the Studebaker line for some years. This has been replaced by an amidship type solidly mounted upon the frame, with a consequent important reduction in the unsprung weight. The engines are entirely new but do not incorporate any radical features. They are all L-head engines with block cylinders, the larger six having 3⅞ by 5-in. cylinders and the smaller six and four 3½ by 5 in. The respective horsepower ratings of the three types are 60, 50 and 35. The small six and four conform to each other quite closely and are solid head types, while on the larger six the cylinder heads are removable.

The 1918 cars being new throughout contain all the engineering features which have proved their merits during the past few years and are naturally thoroughly up-to-date. The hot spot intake with the corresponding type of manifolds is included in the design.

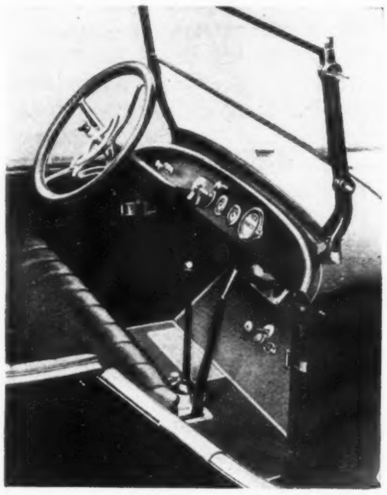
The oiling systems have been revised in detail to give the improved lubrication necessary with high speed engines. The engines are better from an upkeep standpoint owing to greater accessibility resulting from detail features in design. For instance, a change in the fan hub and bracket makes possible the removal of the fan without disturbing the radiator. The new oil level indicator can be readily read at night. A new oil throw ring has been added to the rear end of the crankshaft to prevent leakage through the main bearing. Careful study has been given to the question of external vibration due to loose parts and improper flange connections. The result is that in the new design the flanges on the lower half of the crankcase are much wider. The crankcase itself is stiffer, thus giving greater strength and eliminating the tendency to set up harmonic vibration at critical speeds.

In adopting the amidship gearbox, the transmission system has been entirely redesigned. The gearbox is placed immediately back of the flywheel and is connected with the latter by a flexible Thermoid-Hardy coupling. It is supported by a sub-frame which also carries the rear supporting arms of the engine casting. The gearset bearings are four adjustable Timkens, and instead of the four-jawed or dog coupling ordinarily used, the second speed gear is cut with internal teeth which act as a clutch member engaging with the main pinion when in high gear. There is a new clutch brake also, which tends to facilitate gear shifting. Two Spicer universals are now used in the propeller shaft, which by the use of the amidship gearbox has been considerably shortened, thus lessening the tendency to vibrate. The intermediate section of the shaft is tubular and is butt-welded to the joints at either end.

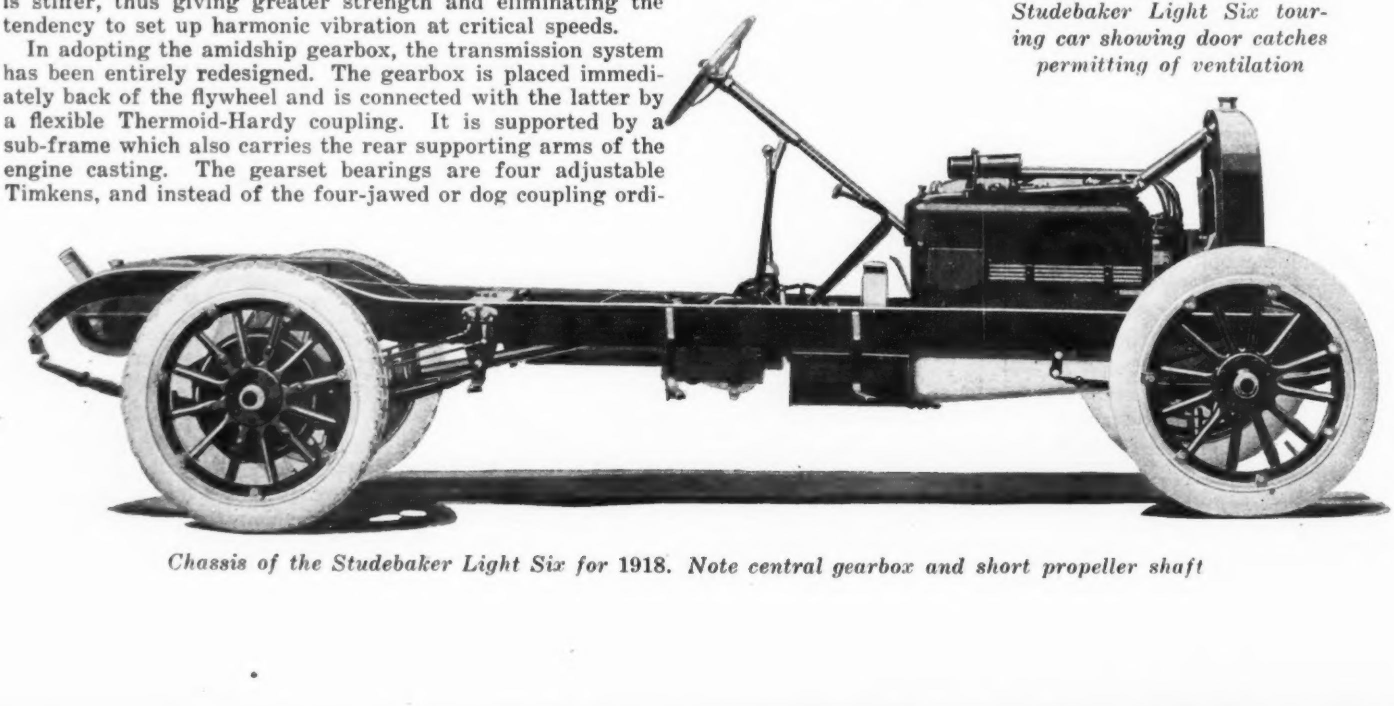
Studebaker is now using an aluminum clutch in place of the pressed steel one of former models. Advantages claimed for this type are lightness and a truer surface, thus giving the clutch leather a better seat. Between the flywheel and the flange couplings is a clutch-release mechanism which is designed with an equalizer which centers the effort when the clutch pedal is pressed, thus pulling the clutch directly back of the spline shaft and preventing it from binding.

Frames are made of heavy carbon steel stock. The four-cylinder model has a frame section of 4½ by 1¾ by 5/32 in., the Light Six cylinder model, 5 by 1¾ by 5/32 in. and the Big Six 5½ by 1¾ by 5/32 in. The new shape of frame which follows the lines of the body is of advantage since it gives a short turning radius, saves weight and gives the motor a better and closer support. In the new chassis designs exceptionally high factors of safety have been used in the frame and every other important part.

The rear kickup of the frame sidebars is sufficient to allow ample jounce space.



Driver's compartment of Studebaker Light Six touring car showing door catches permitting of ventilation



Chassis of the Studebaker Light Six for 1918. Note central gearbox and short propeller shaft

Five cross members and a cross tube connect the sidebars and distribute the load very nearly uniformly. The wide cross member near the rear is of channel section and is well gusseted to the sidebars to resist frame weave. Below this cross member are carried the brake cross shafts with equalizer. These shafts are bracketed to the sidebars, and all of their bearings are lined with oilless bushings. The rear portion of the frame sidebars follows the line of the body sills, and greatly stiffens them.

Two channels run lengthwise of the frame between the sidebars. They are secured at one end to the motor support brackets, the other end resting on center cross brackets. This sub-frame construction serves to carry the transmission case and the pedal shaft brackets.

The Hotchkiss drive is now used, in connection with semi-elliptic springs underslung at the rear. These are of chrome vanadium steel and have the spring eyes bushed with bronze. The bushings are claimed to be true to 1/1000 in. The front axle is drop forged from high carbon steel. The steering knuckle has two Timken bearings for each front wheel, and the knuckle pin, instead of being secured to the axle, is now secured to the knuckle and rotates in hardened and ground bushings pressed into the axle jaws. This design permits of a greater span between the bearings.

Another new feature of the chassis is that in place of the continuous dust pan beneath the engine there is a sectional pan fitting between the frame side bars and the crankcase. This results in greater accessibility of the motor oil pan and greater road clearance at this point.

The generator has been improved by the use of a pressed steel housing and is lighter and smaller than the former type. In other details the electrical equipment is the same.

The lighting switch provides two degrees of dimming, and on the Big Six there are silver dials on all registering devices. The battery terminals have been so designed as to fit practically any make of battery, as a convenience for the owner. The standard type furnished is the 100 amp.-hr. Willard. This is used in connection with a Remy ignition system which has been improved by the use of a waterproof distributer cap.

It is in the body line that the most distinctive changes have been made. The bodies are of low hung types with unbroken lines from radiator to the rear of the tonneau. They have the somewhat angular lines which have become popular in the last few months, and give a remarkably smooth and graceful appearance. In the new models all the doors swing from the rear, and the front doors are provided with catches permitting them to be held open for ventilating purposes. The front seats are continuous, providing increased body strength, and the seat backs are designed to give an improved double cowl effect. Increased room is provided in the forward compartment and there is also more room between the steering wheel and the back of the seat. The tonneau of the seven-passenger model is 2 in. longer than the old model. The slanting type of windshield has been adopted and the shroud and radiator are designed without recesses for the hood.

The Big Six is furnished regularly in options of Brewster green or Purple Lake maroon; the Light Six is dark blue and Purple Lake maroon, and the Four in black enamel. All are completely equipped with Warner speedometer, oil pressure gage, ammeter, gas and air carbureter controls, speedometer dial and dash lamp and Yale switch locks. The headlights are fitted with special diffusing lenses. The Big Six has also a Warner clock. In the rear compartment there is a combination robe and hand rail and the Big Six has a tonneau lamp with an extension cord to reach any part of the car.

Studebaker Big Six seven-passenger touring car mounted on a 126-in. wheelbase

Bird's-eye view of Studebaker Light Six touring car

The foot rails on all three cars are 3½ in. wide and are covered over in limousine style.

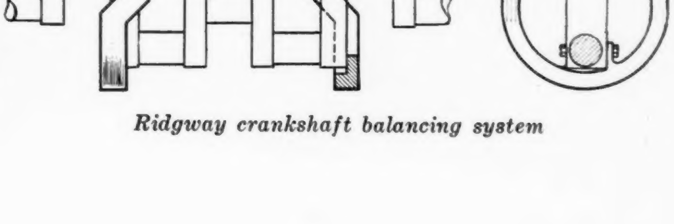
The tire size is 33 x 4½ on the Big Six, 32 x 4 on the Little Six, 32 x 3½ on the Four.

Prices of the new models are $895 for the Four; $1,295 for the Light Six; and $1,695 for the Big Six.

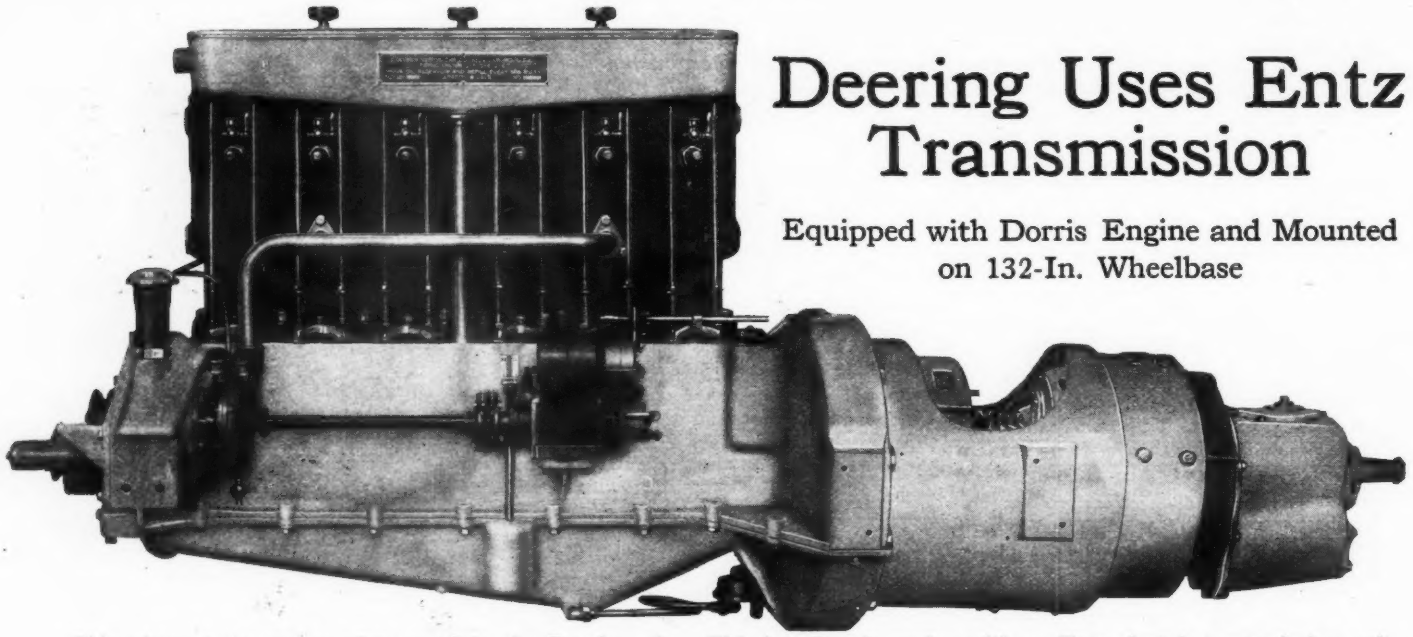
New Crank Balance System

THE system of crankshaft balancing which is claimed to be much cheaper than the majority of other forms is the invention of Joseph W. Ridgway. Briefly Ridgway's idea is to attach to a conventional crankshaft rings either of cast iron or steel, the upper and lower halves of the rings being offset. The rings can be easily attached to the shaft and being, of course, produced under rotation and coupled creating a bending moment on the shaft.

The rings are so proportioned and so arranged on the shaft that the bending moment created is equal and opposite to the moment due to the crankshaft pins and webs. This method of balancing is particularly easy of application to a four-cylinder crankshaft and will be found on the Crow-Elkhart cars in the New York show.



Ridgway crankshaft balancing system



Deering Uses Entz Transmission

Equipped with Dorris Engine and Mounted on 132-In. Wheelbase

Side view of the power plant used in the Deering six. This is a Dorris engine with an Entz electric transmission unit

THE Deering Magnetic car, produced by the Magnetic Motors Corp., Chicago, will have the Entz electric transmission and the Dorris engine. The car is built on a wheelbase of 132 in., and in its other features follows the lines of up-to-date practice. The Dorris engine is a six-cylinder valve-in-head type with the cylinders in threes and dimensions of 4 x 5 in.

As has been explained in these columns previously, the Entz transmission eliminates and performs the functions of the electric starter, flywheel, clutch and gearbox. The engine is operated in the customary manner, but is started by the use of a small lever located on the steering wheel. This lever serves also as a speed control and operates the electric brake.

The Dorris engine has the rocker arms enclosed in an aluminum case with a removable top. This top can be taken off by turning two knurled screws and the housing also contains the upper water pipe, which takes the cooling liquid directly from the jackets above the exhaust ports. The purpose of the housing is chiefly as a dust cover for the rocker arms and valves and it also serves to keep the engine clean.

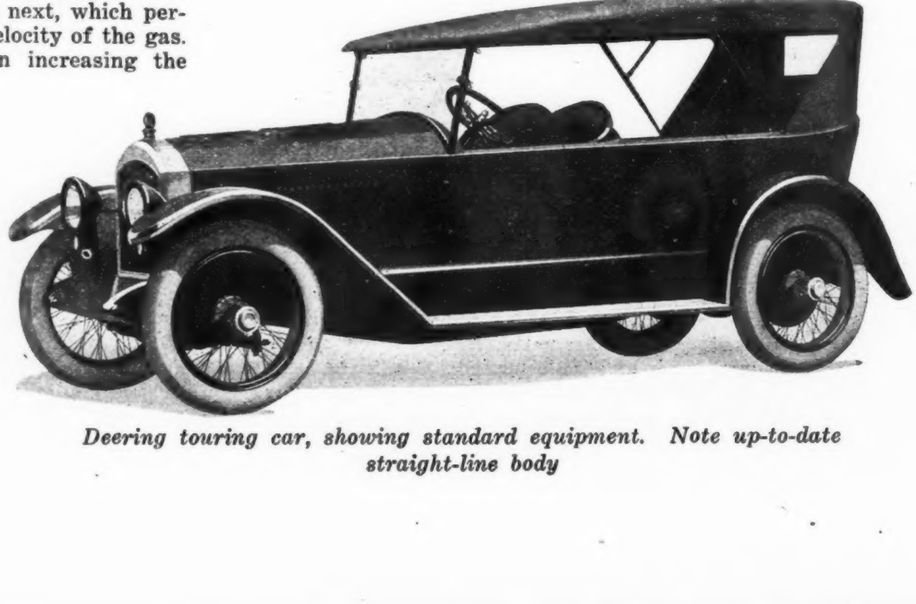
One of the features of the engine is the layout of the firing, so that the first and second sets of three cylinders operate alternately, thus eliminating back pressure and giving a smooth and continuous flow of gases from the carbureter through the two short manifolds to each set of cylinders with the avoidance of any reversal of gas flow. There is a sort of injector action set up in this way which tends to reduce back pressure rather than increase it. On the intake a ramming effect is created by the alternate firing of the two blocks of three due to the short period between the closing of one inlet and the opening of the next, which permits a pressure head to be formed by the velocity of the gas. This is an aid in filling and a factor in increasing the volumetric efficiency.

This layout of the manifolds is one of the chief features of the Dorris engine. It has resulted in a higher output from the engine both because of the better filling on the intake and from the decreased resistance to exhaust. The latter factor has been accentuated by partitioning the exhaust of the first three cylinders from that of the second three cylinders. This partition in the exhaust pipe also prevents any chance of the exhaust from the first three cylinders blowing back and refilling the exhausted cylinder of the second set. With the alternate firing, as explained, this would be the case if no partition were used, as the exhaust valves would then overlap each other to such an extent that when one valve was approaching the closing point another cylinder would open up and refill the first.

Pressure feed lubrication is used with a gear type of pump and an oil gage mounted on the side of the crankcase. Ignition is by Bosch magneto, while lighting and starting is provided by the Entz electric transmission unit. The rear axle is a floating Timken, with the Timken bearings at differential and wheels. The final drive is spiral bevel.

Bearings are used on each side of every crankpin, the purpose of this being to provide a crankshaft in which whip and vibration are eliminated. The main bearings are bronze backed and are lined with nickel babbitt. The camshaft bearings are unique in that seven of them are employed, so that there is a pair of cams operating between two bearings throughout the entire length of the shaft. This is of value not only to prevent vibration, but also in synchronizing the valve timing and to nullify the effects of springing or whipping of the camshaft. This is considered one of the points of the engine which will increase its life.

The Deering car is upholstered in black leather and the equipment includes a top and dust cover, rain-vision windshield with ventilating features at top and bottom, a 60-mile Warner speedometer with season and adjustable trip register, special tire carriers in rear, five Rudge-Whitworth wire wheels with 33 x 5 cord tires, two 10-in. headlights with double bulbs and dimmer, electric tail light and license carrier, electric horn, electric inspection light, robe rail, footrest, set of tools, jack and repair tire outfit.



Deering touring car, showing standard equipment. Note up-to-date straight-line body

Salon Exhibits Show Individuality

Cabriolets and Landaulets Predominate—Marked Improvement in Collapsible Features

NEW YORK, Jan. 2—The fourteenth annual automobile salon which is now running at the Hotel Astor lives up to its traditions of striking the dominant note in fashionable custom body work. The salon is always a body show, and in spite of war-time conditions is again displaying examples which are typical of the finest of the coachmaker's art. Because of the European upheaval the salon this year is the only automobile exhibition of international character to be held anywhere in the world.

While originally limited to motor cars of European design, the salon is now open to the products of American makers, and it is upon the American chassis that some of the finest examples of body design are exhibited. As usual, the exhibition this year typifies the fashions in custom body work and affords a prediction for what will come in a modified way in stock body design.

To a student of body design there are several facts which stand out as typifying the lesson of the salon: the improvement and adaptation of the convertible and collapsible types; the falling off in the divided front seat for touring cars; the practice of building the car body to fit the user; the increasing convenience in the control members; the better mounting of external fittings such as windshields, tire carriers, runningboards, trunk racks, etc.; the tendency toward straight line construction in both open and closed cars, and the more artistic simplicity of body interiors may all be taken as indicative of the features brought out at the Astor exhibit.

Cabriolets and landaulets predominate in the closed car exhibits at the salon. The ingenuity and fine workmanship in taking care of the collapsible features of these cars is somewhat offset by lines which are not as graceful as they should be, due to the exaggeration of the flat top. The flat roof on the closed car tends to give the appearance of an outward flare at the top, with the result that a box-like appearance can hardly be avoided.

Another weak point is in the use of horizontal bonnet lines with the short cowl, which tends to give a sagging effect at the forward end of the front compartment. This is quite noticeable on some of the town cars. The effect is avoided by others in the use of a slanting line at the side of the hood.

There are only two open cars with divided front seats at the show. The consensus of opinion among body makers is that this type is disappearing in favor of the center cowl arrangement. Where the center cowls are used they are larger and more distinct than formerly. There is no doubt a structural reason for the abandonment of the divided front seat in that it cuts an important transverse supporting member of the body. With the center cowl arrangement this transverse member is substantially reinforced with the result that it is much easier to maintain door tightness.

Some of the bodies shown illustrate the tendency to build the car to fit the needs of the user. The dimensions of the seats and the positions of the control members are arranged in these cars to suit the physical makeup of the buyer. Naturally cars of this type are the open design where the owner is to do his own driving. One of the cars which may be mentioned as an example of the built-to-fit type is a four-passenger Murray job all in aluminum. The running boards and body and hood lines are all angular, giving a sort of cubist effect. The driver's seat in this has been laid out to measurements to suit the purchaser of the car, who happens to be the son of Andrew Carnegie.

Another tailor-made body is shown at the Brewster booth where there is a sedan built for the personal use of the president of the Brewster company. This is a square type with the flat roof but in this case the flat roof has been relieved by the sloping front line of the body so that the eye is led gradually off the top of the car instead of being somewhat shocked by the abruptness generally given with a combination of flat side lines and flat top. Even the slit in the windshield is correctly placed in this car so that it will not interfere with the vision of the particular driver who will use the car.

Body attachments and other parts of the structure which must be added to the exterior are now fastened or built in with the greatest amount of rigidity possible. Where two bolts were thought to suffice for windshield supporting members three and four bolts of larger size are employed. Fender supports are universally more substantial as are also headlight brackets and fittings universally.

In the way of new products there is very little to be found at the salon. The Biddle company has its new Duesenberg engine-equipped car on the floor and a new company known as the Mercury exhibited for the first time. The new Biddle, selling for $3,650, is very much the same as the previous type on the same 122-in. wheelbase. The former Biddle is also continued selling for $2,650 with a Buda engine. No material changes have been made in the chassis except that the drive members have been strengthened to take the greater output of the Duesenberg engine.

The Mercury cars made by Mercury Cars, Inc., Hollis, L. I., have open models priced from $2,750 to $2,950 and closed models at $3,600 to $3,900. The body work is custom style exclusively. The car exhibited is a four-passenger job and is one of the two divided front seat open types on the floor. It has the angular side lines which are popular this season.

White, Locomobile and Simplex, passenger car manufacturers of long standing, showed complete lines of bodies which are more accurately of a stock nature than the other cars on the floor. Nearly all the other exhibits represent the individual efforts of custom body designers.

White shows a coupe in dark and light gray finish with cloverleaf seating which is an example of compactness in this style. The use of the two shades tends to break up the appearance of flatness which would otherwise be likely to be apparent due to the ample head room and flat roof.

Fageol, which has discontinued the manufacture of passenger cars owing to government appropriation of the Hall-Scott engine plant, shows the last of twenty-five of these cars which were put through production. The chassis alone sells for $10,000 and the entire car for $13,000. This car is geared 1½ to 1 and 750 revolutions of the motor represents a mile of travel.

Phianna has two town cars on exhibit both of which show a tendency toward narrow lines in bodies of this kind. Cunningham, Lancia, Murray and Rolls-Royce all show town and convertible town bodies which are typical of the high narrow design which seems to be nearly universal for the formal type of city vehicle.

One of the features of the show is the rectangular lined Brewster-Knight sedan which is finished in gray with red running gear. This car is a good example of light weight body design, the body itself weighing but 785 lb., or about 400 lb. less than the average Brewster-Knight sedan body. It has four doors and is finished in cane and spruce. The inside of the doors are lined with the caning material and this does away with the usual interior panel. The result is the exceptionally light weight as noted. This car is covered with a brown canvas top which extends forward so that it forms a peak for the windshield. The windshield itself has an angle formed by a horizontal projecting line and the shield does not rise and fall in the usual manner but is raised and lowered through a space of several inches by means of a lever control.

Further Increase in Pressure Feed May Result from Shortage of Alloy Steel

Bearing Speed Increasing Because of Engine Characteristics and Larger Shaft Diameter

OWING to the continual tendency toward stiffening crankshafts, there is an increase in pressure feed systems. This is natural because engine speeds, as well as crankshaft diameters, have increased, thereby giving a higher linear speed to the bearing. When bearing speeds go above 1000 ft. per min. linear velocity, the matter of maintaining the oil film becomes of the highest importance if the bearing is not to be destroyed. Even the highest quality of bearing materials will disintegrate quickly unless metal-to-metal contact is prevented. For this reason the utilization of a pressure feed is necessary.

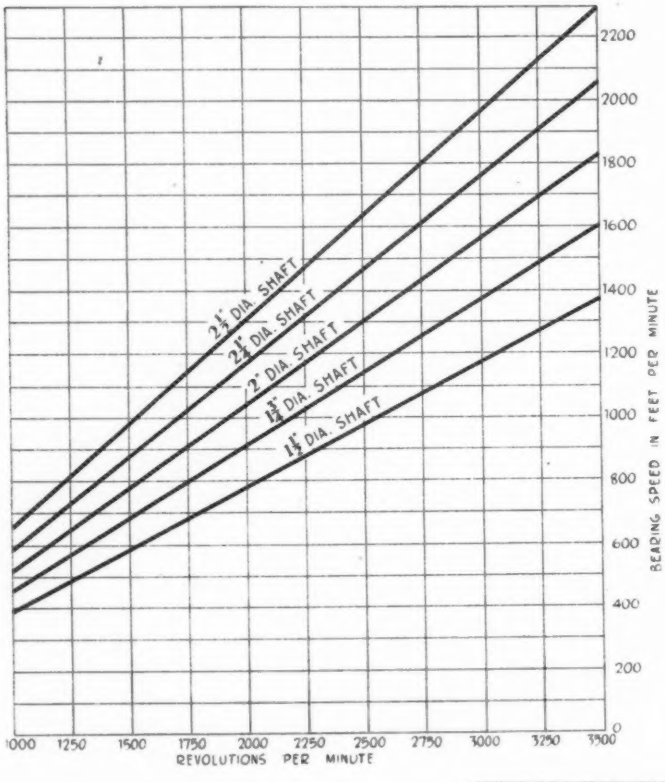
There is a tendency for the molecules of the bearing metal to be pulled out by the revolving shaft, and it is this frictional pull rather than abrasive wear which causes the destruction of the bearing.

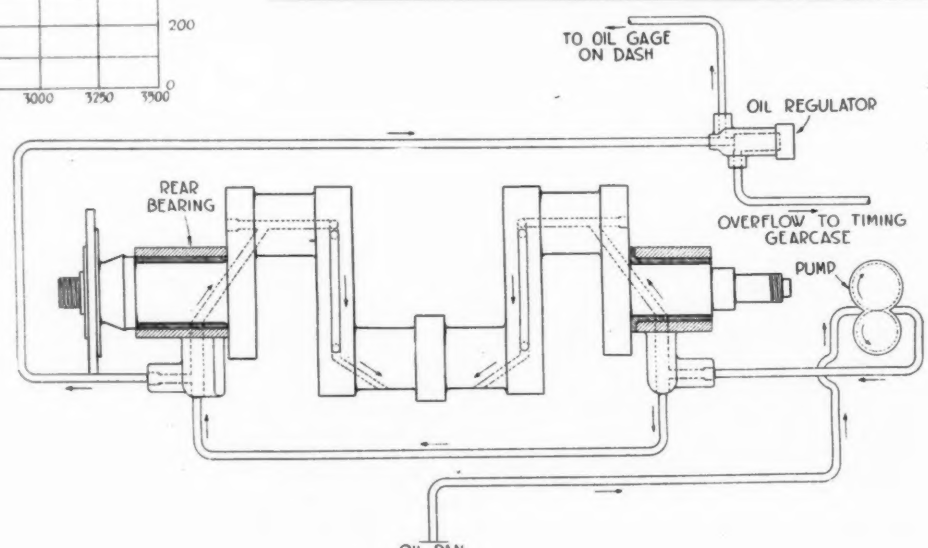
Working pressures for oil systems range from 2 to 60 lb., depending on the speed at which the engine rotates, the method of oil feed, and largely on the personal beliefs of the engineer designing the system. There are two distinct functions of the oil in reaching the main crankshaft bearings, one being to lubricate the surface by maintaining an anti-frictional film between the surfaces of the bearing and the shaft, and, secondly, a cooling function in which the flow of the oil is made use of to carry off the heat generated by friction.

Systems using the oil as a lubricant as well as a lubricating medium, and which operate with a working pressure of approximately 40 lb. per sq. in., are particularly well adapted for high-speed engines. A system of this kind generally employs a crankshaft drilled so the oil is conducted directly to all the crankshaft bearings and to the lower connecting-rod bearings. It is also quite customary to include the camshaft in the circulating system, so that the camshaft bearings as well as the cams themselves are always working in a flood of oil.

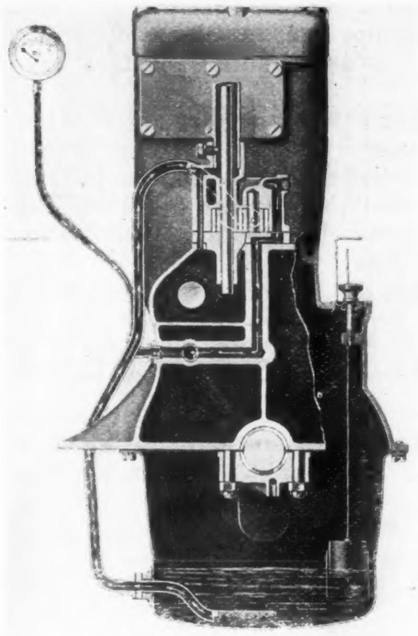
Large Strainer Necessary

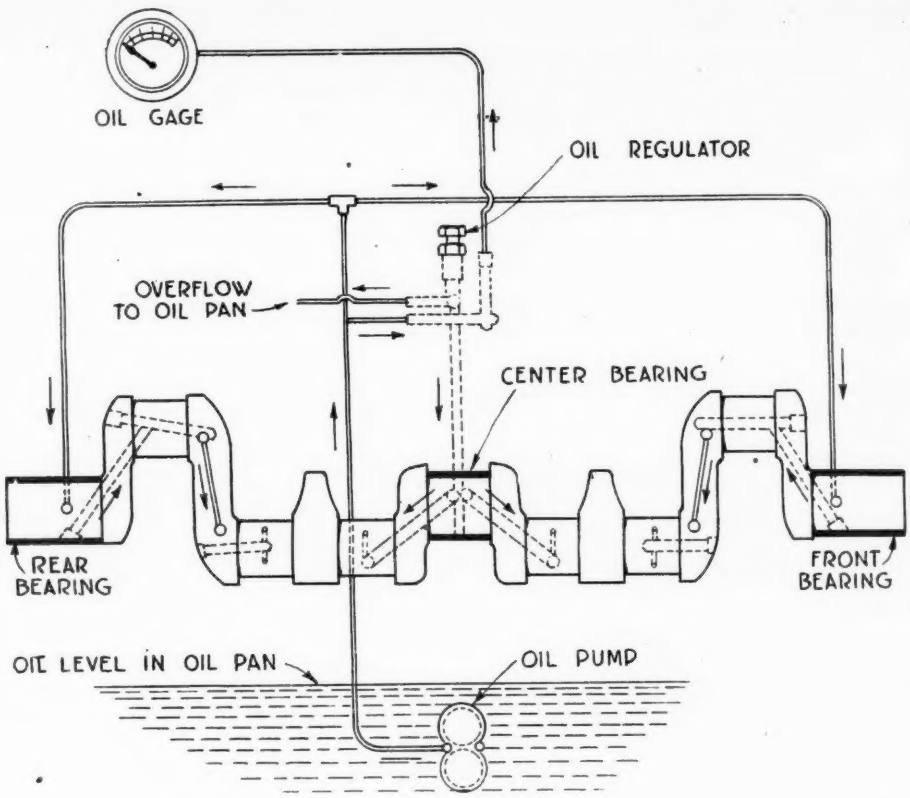
One of the points which must be carefully watched in a system of this kind is that the brass wire gauze strainer is of a sufficiently large area to give the right amount of strainer space for a system which requires as much oil flow as this does. Should a small part of the area of the strainer be clogged when the strainer is only just sufficient to allow the passage of the proper amount of oil,





Above — Curves illustrating linear speeds of main bearings for different diameter shafts between 1000 and 3000 r.p.m. Right—Oiling diagram of the Oldsmobile 44 showing arrangements of leads and direction of flow





Above—Diagram of the Hupp pressure feed, showing self-priming pump and oil leads. Right—Layout of the Oakland-Northway oiling system, showing the path of oil and method of pressure adjustment

the result would be that the oil would back up to such an extent that the pump feed may be starved, while the interior of the engine itself may be flooded so the rods will dip, causing an undesirable splash action and consequently allowing the engine to smoke.

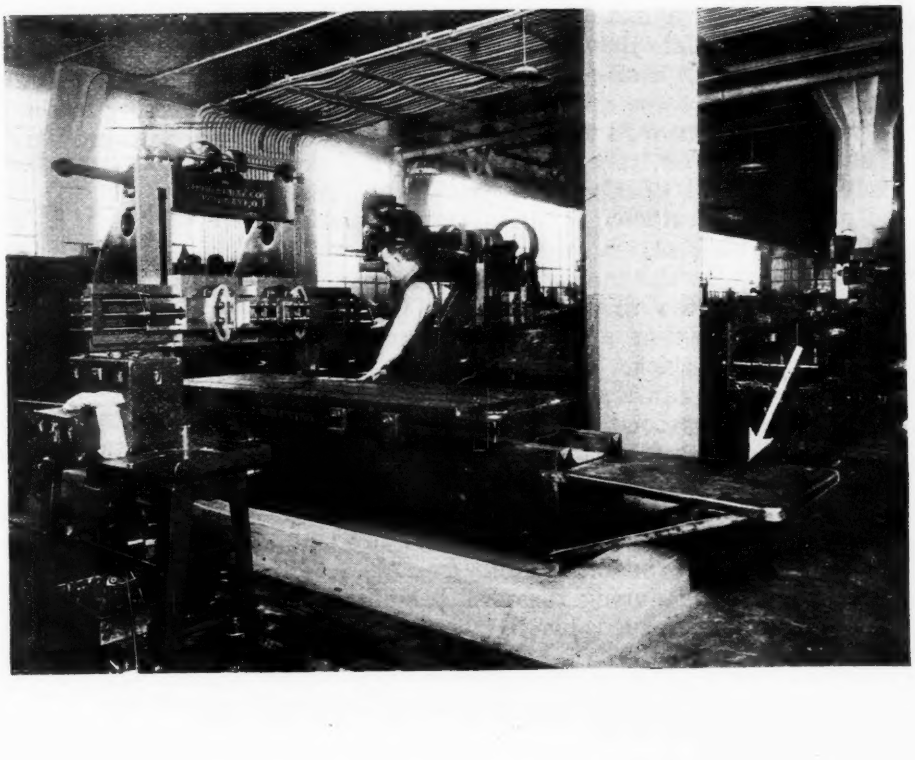
For the sake of appearance and cleanliness, it is advisable that the oil system be self-contained, with the exception of the pressure gage on the instrument board.

With conditions making it desirable to economize in alloy steels, it may be necessary to use carbon steel shafts of larger diameter. This will naturally give an increase in bearing speed, as shown in the curves herewith, and it may be that designers, changing to the larger diameter shaft, will have to alter the oiling system either by a change from splash over to pressure or by an increase in pressure, since it is quite customary to have the main bearings under pressure even though the remainder of the engine is oiled by splash.

Two typical pressure-feed layouts as used in passenger-car practice are shown herewith. The Oldsmobile Model 44 and the Oakland six are the two shown. On the Oldsmobile the pressure used on the system is not over 20 lb. maximum and 2 lb. minimum, while on the Oakland the pressure is arranged somewhat lower, so that at 20 m.p.h. the working pressure is from 10 to 15 lb. The pressure is set on the Oakland model by the adjustment shown in the drawing, controlling an overflow by-pass to the oil pan.

A Planer Safety Appliance

The cut opposite illustrates a safety device used in the plant of the Ford Motor Company. It is a planer extension, put onto the bed of a large planer, and prevents persons walking past the machine through the aisle from being struck by the planer table



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War Show Spirit

THE big manufacturer who dropped the remark at the Detroit Athletic Club that he would not attend the automobile show this year because, to use his exact words, "It is all right to go there in normal times to play, but these are busy times," has not the best war attitude toward the coming shows.

The situation is entirely reversed; in normal times it may be all right to stay away, but under present conditions every automobile manufacturer can perform a desirable function at the show.

Dealers come to the show by hundreds in normal times, and this year they are coming in as great numbers as ever; they are coming to learn of the future business outlook. Under these circumstances the manufacturer can scarcely afford to stay away.

Now is the time when the dealer needs the national analysis that comes from talks with the best minds in manufacturing organizations. These men should be on hand and should be there every minute. The dealers need more courage. Courage is bred of a correct analysis of business fundamentals. This has been evidenced during the past 6 months, and the opportunity afforded by the show should be taken advantage of.

The show this year is not to be taken in the light of an Oriental bazaar nor a carnival to bolster up the prospect list. It is an essential business get-together.

The industry is on trial and the jury which must be convinced is the dealer. The manufacturer knows that future business is as firm as the realization that motor transport has come to stay can make it. The dealer should be impressed with this. The manufacturer should show him.

Do your bit by being at the show.

Abandonment of the AeroShow

AFTER considering the matter from every angle the committee in charge of organizing another aero show for New York City has decided to drop the project. Government departments apparently looked with some disfavor on the plan, and it is hardly possible that the aircraft industry was greatly interested, in view of the fact that all established firms are rushed to the limit with work. Just now, also, there is no need to stimulate public interest by artificial means, as aircraft development is receiving all needed encouragement through Government channels.

One reason mentioned in connection with the abandonment of the show is that it would have been an unnecessary tax on our transportation system, which is already strained to its limit. It would have been necessary to carry much bulky material from the factories—many of them located far inland—and back again, and show attendants and out-of-town visitors would have added to the passenger traffic.

No show made up exclusively of historical and experimental exhibits would have served its purpose and satisfied the public. It would have been necessary to secure the co-operation of leading firms of the industry, and preparation of the exhibition material at the plants of these firms might have interfered with production on Government orders, which would have been impermissible.

Therefore, while it cannot be denied that the proposed show promised certain beneficial results, as outlined in these columns some months ago, it is undoubtedly to the advantage of both the national and the aero industry that no show be held this year.

Tractor Service

WHEN an automobile owner complains to a dealer regarding some trouble with his car, the latter will often say: "Drive her around to our service station some day and we will have one of our men look her over." Such a proposal generally appeals to the owner, because he is most likely to come by the station anyway in his driving, or even if he has to go out of his way say 5 miles, it is only a matter of a few minutes.

It is an entirely different proposition with the tractor, however. In the course of its regular use the farm tractor never comes to town. It is a very slow vehicle and road travel is particularly severe on it. Moreover, during the period of its most in-

tense use, when it is most likely to require the attention of service men, the farmer is exceedingly busy and cannot spare any time from his work. The very fact that the service man on his motorcycle or automobile can travel at least ten times as fast as the farmer with his tractor and needs to move only a small fraction of the weight makes it obvious that the service man must go to the tractor—that the tractor cannot be brought to him. This is, moreover, the practice with respect to other heavy, slow-moving farm machinery, such as seeders and binders.

It would seem that tractor service should open up an excellent field for the motorcycle. Ordinarily it is not necessary to carry much heavy equipment. What tools and instruments are required might be carried in a leather roll strapped to the machine, but if this does not suffice a side attachment with carrier box would give all the carrying capacity needed.

It is true that the farmer has learned a great deal about gasoline engines and kindred mechanism by his experience with pumping engines, automobiles and lighting sets, but the day where he can do without the service of the expert is still far off. The fact that the tractor is tied to the field, so to speak, that it cannot be taken great distances to machine shops, makes it necessary to organize service for it on an even more elaborate scale than for automobiles.

Economy in Transportation

THE world-wide wave of economy cannot pass over such a fundamental of modern life as transportation. It is affecting every other phase of human existence and it cannot help but affect our mode of transportation as well. In fact it has already done so. Our railroads have been taken over by the government.

If the railroads are affected automobiles will also be affected. They will have to be operated more economically, and the cars of the future must be more efficient from a transportation basis than ever before. More miles of travel per dollar of expense must be given to the owner, better performance, better endurance, better service in every direction must come back to the purchaser of automobile transportation.

As a nation we are through buying cars, we are buying transportation itself. The car of to-day is not judged by any other standard than by the amount of transportation it provides and the quality of this transportation. If we have been extravagant in the past, we are now becoming economical. Our daily habits are undergoing a marked change. We are getting down to a war-time basis and our method of getting from place to place must be altered in conformity with the other changes that have taken place.

First cost as represented by the price mark on an automobile is not necessarily effected by this change in viewpoint. The only difference is that buyers are going to scan more closely the return for their money and if the difference between a low-priced car and one that is higher priced is made up in better performance, in better service, in more comfort, the price mark alone is not going to serve as a barrier. Useless extravagance in weight, engine size, gasoline consumption, tire wear and even in space required are all going to be checked. The 100 per cent efficient car would utilize every inch of wheelbase, it would have the lightest possible weight per pound of passenger load, it would utilize ever ounce of energy in the fuel, every bit of rubber in the tires and every bit of lubricating quality in the oil. We will never have the 100 per cent perfect car, but we must shoot as closely as possible to the mark to meet the changed demands of automobile buyers who no longer buy their vehicles by the pound.

The Coming S. A. E. Meeting

AS was the case at Washington last summer, the winter meeting of the S. A. E. in New York next week will be confined to a single day. As the most important engineering development in this country during the past six months has been the design of the Liberty aircraft engine and the design of the Liberty trucks, and as the S. A. E. has been closely connected with this work, it is fitting that these pieces of engineering work have been chosen as subjects of discussion. It will be interesting to the membership to hear directly from the men responsible for these designs the reasons behind their work. Neither the aircraft engine nor the motor truck is a one-man job and we presume that all of the features involved were fully discussed over the drawing table, so that the chief designers are thoroughly familiar with all the pros and cons not only of the features adopted, but of others that might have been used instead. As it is seldom that engineers fully agree regarding the relative advantages and disadvantages of different constructions it is not unlikely that a spirited discussion will ensue when these subjects are taken up.

Much of the time at the coming meeting will be taken up with a consideration of the report of the Standards Committee. A bulletin containing the reports of the various divisions awaiting action at the Standards Committee meeting has just been issued and contains easily the largest number of items ever taken up at any semi-annual meeting. This increased volume of work of the Standards Committee results, of course, in part from the launching out into new lines and the appointment of new divisions, but it is also in no small measure due to more energetic management of the Standards work than prevailed in the past.

Wanted—Specialists

THE great need of specialized knowledge was never so keenly recognized as now. The talk about a shortage of skilled labor when boiled down to its ultimate state is nothing more or less than the result of the demand for specialists. We are not short of man power, and whereas the shortage of labor may be stated in terms of thousands, the shortage of specialists means the urgent need for a few hundred right men for the right jobs.

Latest News of the

Search Reveals No Labor Shortage

Vanderlip's Theory Disproved by Figures Showing Army of Men Out of Work—Some Skilled Men Needed

NEW YORK CITY, Jan. 2—The Frank A. Vanderlip statement made in his speech-making tour a week ago to the effect that the shortage of overcoats by our soldiers was due directly to a labor shortage, and that much of this labor was engaged in what Mr. Vanderlip describes as industries not connected directly with the war, has been denied by figures furnished by the Clearing House of Labor in this city, which is an organization in touch with 100 employment bureaus throughout New York state. The bureaus in question are described as non-fee bureaus in that they do not charge any fee for placing a worker in a job. Morris L. Ernst, director of the bureau, says that in New York City alone there are 30,000 garment workers out of employment, so that with this number of idle garment makers the labor shortage referred to by Mr. Vanderlip does not exist.

Mr. Ernst gives some clue to the possible labor situation when he says that contracts for clothing have been given to concerns without factories, and that factories had to be built and labor moved in before production started. Such conditions must not be interpreted as meaning a shortage of labor, but rather a failure in bringing the worker and the job together.

Vanderlipian Theory Disproved

Mr. Vanderlip's Vanderlipian theory that there is a general labor shortage throughout the country and which he is talking so generally on in his war-saving certificate campaign around the country, has been unqualifiedly challenged by the Department of Labor in Washington, which calls Mr. Vanderlip's statements about such shortage not only untrue but unpatriotic and not common sense, because they tend to create a panicky condition in industries which is very injurious to our activities in the war. This is not the first time that the Department of Labor, which is closely in touch with labor conditions throughout the country, has blankly denied the statements being credited to Mr. Vanderlip on this subject.

At present there is no acute labor shortage in this country. The Western shipyards need 25,000 men and the Department of Labor knows where to get them at the proper time from west of the Mississippi. The Eastern seaboard shipping yards need a few men who can be secured in their home towns. In seven or eight months there will be a demand for about 40,000 skilled workers, and not 400,000 as some reports have it. The Department of Labor states it knows where to get these men without serious disturbance to any industry. The 40,000 skilled men needed will come from 30 different trades, one of which has 700,000 members, which shows how diversified the demand will be and how little it will affect any industry. The greatest present labor problem is that of man-adjustment and getting together the many ideal men who are found in some cities where many plants need them. The situation is common to almost every city in the country.

Mr. Ernst, speaking with regard to the labor situation in New York state, gives numerous figures that are illuminating on this subject.

An Army Out of Work

In New York City there are 500 expert jewelers out of work; it is reported that in Boston 1000 men in the same line are seeking employment. These men are experienced in working with delicate machines and in performing exact operations and yet great difficulty is being found in placing them in lines where experience of this nature would be invaluable. While searching for positions for these men, fifty-five plants were written to and only two needed any men. The Aircraft Manufacturers' Assn. reported less than 10 days ago that they have all the men they can use.

There is admittedly a shortage of specialists. This is always true regardless of any times and particularly so whenever a big change of conditions is taking place. Some of the employment agencies in large centers along the Atlantic Seaboard, such as New York City, for instance, have from 100 to 200 men looking for work every morning. One of the most noticeable points in this connection is the stand taken by those out of work in refusing to accept anything but the choicest kinds of positions at the most advanced prices. This condition is directly traceable to the stories which have been going forth that a shortage exists. Naturally this puts the idea into the mind of the laborer that he can command his own price with the result that he is loath to take anything that does not pay him more than would normally be expected.

A small item in a New York newspaper, dated Nov. 14, to the effect that a shipbuilding concern needed 2000 men brought scores of letters from all over the country requesting particulars. A large percentage of these men were skilled laborers seeking high class jobs. This is significant and shows that no shortage of man power exists at the present time.

Award Contracts for 4100 War Trucks

WASHINGTON, Dec. 29—Contracts for 4100 war trucks, to be delivered early in 1918, for service in the Aircraft Division of the Signal Corps, have been awarded. These include 2200 of the 1½-ton light trucks mounted on pneumatic tires and specially intended for high speed work, and 1900 of the 5½-ton trucks of similar design but mounted on solid tires. The contracts have been awarded as follows:

1½-Ton Light Trucks	
Signal Motor Truck Co.	500
Republic Motor Truck Co.	500
Denby Motor Truck Co.	500
General Motors Truck Co.	700
3½-Ton Heavy Trucks	
Standard Motor Truck Co.	250
United Motor Truck Co. (Grand Rapids)	250
Federal Motor Truck Co.	500
Kelly-Springfield Truck Co.	500
Velie Motor Co.	400

Plan Six More Truck Trains

DETROIT, Dec. 31—It is expected that six more United States Army truck trains, each consisting of thirty Packard trucks, will leave this city overland for the seaboard. The Packard Motor Car Co. has received an unofficial notice to prepare these trucks for the drive. The Government, however, is to supply the drivers, and these must be organized before the drive-away takes place. It is stated that the first trip overland was entirely successful and the trucks will soon be running on a regular schedule from the factories.

Airplanes Can Now Be Insured

WASHINGTON, D. C., Jan. 2—The National Advisory Committee for Aeronautics has taken up the subject of insurance for aircraft, and announces that it has arranged with insurance companies so that they will now insure aircraft against fire while in flight, on the earth, or on any lake or river in the United States. Caution is advised by the committee to avoid the congestion of hangars which are usually remote from fire protection.

American Tractor Corp. Formed

RICHMOND, VA., Dec. 31—The American Tractor Corp. has been organized with a capital of $1,000,000 to manufacture and sell traction engines. F. S. Crosby has been elected president and H. H. Chalkley secretary.

Automotive Industries

Class A Trucks Reach Washington

White, Denby and Autocar Vehicles Encounter No Difficulties En Route

WASHINGTON, D. C., Jan. 2—The three samples of Class A standardized war trucks which were manufactured in the White, Denby and Autocar factories, and were driven overland from these factories, arrived in Washington in good condition, none of them experiencing any mechanical troubles. The trucks, with load, averaged 5.3 miles per gallon, and their speed over the highways averaged 17 m.p.h. Governors were set to regulate the speed between 13 and 17 m.p.h.

The truck assembled by the Denby Motor Truck Co., Detroit, took 9 days for the overland trip. The one assembled by the White Motor Co., Cleveland, required 7 days from that city to Washington, and the one assembled by the Autocar Co., Ardmore, Pa., required 5 days for the trip. The Denby picked up the White at Cleveland, and these two in turn picked up the Autocar, so that all three arrived in Washington together.

The first AA standardized truck will probably be finished before Jan. 15, as per schedule. The parts for this truck are now almost complete.

Two models of the standardized A truck will be given a series of severe tests in and around Washington for several weeks. The third model of these trucks will be turned over to the drafting department.

To Fix More Steel Prices

WASHINGTON, Jan. 2—A bill meeting the ideas of the President as to additional legislation necessary to the fixing of prices of steel and iron is to be pushed vigorously and promptly by Senator Pomerene of Ohio. Senator Pomerene, who fathered such a measure during the special session of Congress, is to revive his bill, it is understood, and push it at once. He has had conferences with the President on the subject. The provisions of the bill probably will be extended to include agricultural implements, it is said.

Jackson Munition Corporation in Light

JACKSON, MICH., Jan. 3—The proposal to form a corporation to manufacture munitions here similar to the one recently formed in Detroit is slowly taking shape. Local manufacturers have appointed two committees to ascertain whether such a corporation would be preferable to manufacture by individual companies. One committee will investigate the formation of the Detroit corporation and the other will make local investigations. Two plants are being considered as suitable for the use of a shell corporation. One of these is the Jackson automobile factory and the other is the old Imperial plant.

Troy to Make Trailers for Government

TROY, OHIO, Jan. 2—The Troy Wagon Works Co. has received a Government order for 100 two- to five-ton Troy trailers of special design for the Signal Corps.

Lansing Companies Get Orders for Escort Wheels

LANSING, MICH., Jan. 2—The Prudden Wheel Co. and the Auto Wheel Co. have received Government contracts for escort wheels amounting to $3,000,000. The contracts must be completed by Dec. 31, 1918, and are proportional to the respective production capacities of the two companies. It is estimated that the Auto Wheel Co. will require 800 additional employees to complete the work in that time. Other big orders for the same type of wheel have been placed with the Kelsey Wheel Co., Detroit, and the Hayes Wheel Co., Jackson.

To Facilitate Grand Rapids Airplane Work

GRAND RAPIDS, MICH., Jan. 2—The Federation of Furniture Manufacturers here, to which about 300 local industrial plants belong, is appointing a sub-committee to act as a clearing house for Government orders. Peter B. Schravesa, president of the School Equipment Co., is chairman of the committee. Several million dollars' worth of airplane parts will be ordered, it is expected.

Stearns to Make Rolls-Royce Airplane Engines

CLEVELAND, Jan. 2—The F. B. Stearns Co. has received a contract stated to involve several million dollars for the manufacture of airplane engines for the British Government. This is a sub-contract under the British Rolls-Royce Co. and under it the Stearns Co. will manufacture Rolls-Royce engines complete except for a few minor parts. The contract will require several additions to the Stearns plant and a directors' meeting will be called this week to complete arrangements for enlargement. It is stated that though this contract will require some slight curtailment in the production of Stearns-Knight cars manufacture will be continued.

Prompt Unloading Is Mandatory

Railroad Dictator Threatens Dilatory Dealers with Embargo—The Situation

WASHINGTON, D. C., Jan. 2—Secretary McAdoo, who is now railroad dictator, has issued an order to-day to the effect that any consignee who does not promptly unload freight cars and release them for return trips will be embargoed. This order has a distinct meaning to the automobile industry, both to the manufacturer and the dealer. Many dealers had been receiving shipments of automobiles that they were not expecting from the factory and had made no provision for the immediate unloading of them, in which case the factory was at fault. If these unloading delays are continued the dealer will be embargoed. New England dealers have been constant violators of this unloading problem.

Many dealers do not realize how closely they are being watched in this work. There are twenty or thirty local committees of the American Railroad Association in different parts of the country. In the same cities there are other committees representing the national, industrial traffic league, which is the national organization of shipping interests. Both of these sets of committees work together. Flagrant abuses of dealers not unloading automobile shipments promptly are reported to the National Automobile Chamber of Commerce, but there are hundreds and thousands of cases which are not so reported. It is dangerous work for the dealer to delay an hour in this unloading work.

In addition to the two sets of committees watching the situation there are scattered throughout the country inspectors of the Railroad War Board who are moving about all of the time in search of violations of this unloading regulation.

The taking over of the railroads by the Government looks like increased railroad facilities, and can only be considered as beneficial to the general situation. The outlook is very favorable for the automobile industry in general, as the railroad dictator is not considering any move at this time that would injure any of the industries.

The policy is one of construction. The Railroad Dictator has issued orders creating genuine pooling of railroads, appointing capable assistants and promising an increase in wages to all railroad workers, requisitioning 1800 locomotives originally designed for foreign

service and ordering many lines not requiring their engines and cars to transport them to the congested districts.

Many passenger coaches will be converted into freight cars and additional freight terminals will be built as required. Common freight terminals will be arranged in Chicago, New York and New Jersey, and the Railroad Dictator also plans to construct many new tracks, freight cars and engines, all of which, it is hoped, will care for freight requirements of the war, aided by electrical lines, waterways and motor transportation without creating disturbance to any industry.

Fuel Situation Easier

DETROIT, Jan. 2—Although the fuel situation is bad here it is not expected that industries will be harmed to an alarming extent. Michigan Fuel Administrator W. K. Prudden has ordered that all emergency coal entering Detroit be used first to alleviate any shortage for domestic use and any surplus turned over to the industries. At present most industries are running at almost normal capacity though there have been some instances of shut-downs. Briscoe, for example, shut down 2 days last week and closed at 2:15 p. m. several days owing to lack of coal, but is running full time now. Oakland, in Pontiac, is short of coal but is running full time. Both Olds and Reo have plenty of coal for the present but the future looks bad.

Jobbers Ready for Convention

NEW YORK, Jan. 2—The third annual meeting of the National Association of Automobile Accessory Jobbers will be held Jan. 14-15-16 at the Hotel Astor in the North Ball Room on the eighth floor. These three days will be devoted to the open sessions of the association. Committee meetings will be held Jan. 11-12, the last two days of the New York show.

Commissioner William M. Webster, in the convention program, states that the association has continued to grow during the past year and enters 1918 with indications of continued steady growth. There have been about a dozen resignations, due, he states, to the discontinuance of manufacturers and to the attitude of the Ford Motor Co. in regard to its dealers acting as jobbers.

Stewart to Make Airplane Wheels

INDIANAPOLIS, Dec. 31—The Stewart Wire Wheel Corp. of Frankfort, Ind., has signed a Government contract to manufacture 4500 wire wheels for airplanes. Approximately $45,000 is involved in the order.

Gilette Brings $151,000

MISHAWKA, IND., Dec. 31—The Gilette Motors Co. has been sold to M. W. Mix, president of the Dodge Mfg. Co., and the sale has been approved by the South Bend Circuit Court. The consideration was $151,000. In July, 1916, the Gilette Co. was formed to take over the plant and patent rights of the Wilmo Co., accessory manufacturers, Chicago.

Detroit Calms Down Before Show

Coal Situation Relieved—Manufacturers Start for New York

DETROIT, Dec. 28—In spite of the abnormal conditions that have at times seemed to threaten the automobile industry, conditions in the past week have calmed down considerably, and manufacturers are preparing to attend the New York show and get ready for Spring business. Throughout the city and state the coal situation has eased up, due partly to the holidays, but more directly to receipt of coal shipments.

Recently 1800 carloads of coal arrived in Detroit, and there is a prospect of eight or ten times that amount arriving in the next ten days. Grand Rapids reports every dealer supplied, and 100 tons on hand. The Sparks-Withington Co., Jackson, says that though the electric power company has only a limited supply of coal on hand, they, personally, have sufficient. This company also states a more cheerful outlook on the part of manufacturers. Some time ago stop-orders on parts for manufacturers were more or less common, but recently orders have been coming in in a manner that indicates that makers are getting their nerve back, and going ahead on a square basis.

There is a strong possibility that the automobile and parts manufacturers of Jackson will form a shell company similar to that recently formed in Detroit. Last week Mayor Sparks, Jackson, received a telegram from A. W. Copland asking if the manufacturers would be interested in forming such a company, to which the manufacturers replied affirmatively. A survey of the companies will be made, and a committee may be sent to Washington to arrange the details.

The Harroun Motor Co., Wayne, is rapidly speeding up production, and is now shipping 30 cars a day. Freight car and coal shortage, hindering the Detroit manufacturers, is less acute in Wayne, and Harroun reports no difficulty in that direction.

During the past week the Liberty Motor Car Co. has shown a marked expansion in its dealers organization, and manufacturers are optimistic for the coming season. Among the new agencies established are: F. E. Styvesant Co., Cleveland, with branches in Toledo, and later in Columbus and Cincinnati; J. D. Moore, Walla Walla, Wash.; Twin City Motor Car Co., Minneapolis; Edgar F. Sanger Co., Milwaukee, and the Means Automobile Co., Des Moines.

As an example of the further working out of the drive-away problem, to relieve the freight car situation, two cases are cited whereby passenger cars have been delivered on trucks overland. In one case, three twin-six Packard enclosed cars were loaded on Packard 3-ton trucks, and started on Dec. 24 for Baltimore, a fourth truck carrying a passenger car body. The second instance is that of a Washington, D. C., cartage man who contracted to bring two Cadillacs with him on two Packard 3-ton trucks he was driving back for his own use.

Stevens Point for Trenam Tractor Site

STEVENS POINT, WIS., Dec. 31—The Trenam Tractor Co., Milwaukee, organized several months ago with $400,000 capital to manufacture a tractor designed by J. J. Trenam, has decided to establish its permanent plant and headquarters in Stevens Point. The company has purchased the entire plant and holdings of the Central City Iron Works, Stevens Point, consisting of a large malleable and grey iron foundry, machine and assembling shops, office and warehouse building. The first castings for the new tractor have been made already. The company will furnish parts to other tractor manufacturers and railroads.

Dump Bodies from Milwaukee

MILWAUKEE, Dec. 31—The Horizontal Hydraulic Hoist & Body Co. has been organized with a capital stock of $50,000 to manufacture automatic dump bodies and hoisting devices for motor trucks. Arrangements are now being made for the establishment of a factory in Milwaukee. Charles F. Millmann, Edward R. Bacon and Benjamin A. Reese are the incorporators.

New Erd Kerosene Engine

SAGINAW, MICH., Dec. 30—The Erd Motor Co. will manufacture a kerosene burning tractor motor larger than the present model. This will embody radical changes in design and have greater power and economy. The Erd plant will be expanded to give added facilities for the manufacture of the new tractor.

Phoenix Rushed with Government Orders

EAU CLAIRE, WIS., Dec. 31—The Phoenix Mfg. Co. is delivering a number of Phoenix Centipede tractor trucks to the United States Quartermaster's department in Texas for exhaustive army tests. The trucks were constructed under Government supervision and employ the well-known creeper-type driving principle.

Airplanes from Indianapolis

INDIANAPOLIS, Dec. 31 — Preliminary incorporation papers have been filed by several well-known Indianapolis business men who intend to organize a corporation here to manufacture airplanes. The company has been capitalized at $1,000. The directors of the company include Albert D. Johnson, secretary-treasurer of the Diamond Chain & Mfg. Co.; A. B. Jennings, a real estate dealer; Lewis Wallace and Joseph T. Markey, attorneys, and George H. Cottrill, a lumber dealer.

First Motor Truck Train Completes Trip

Proves Feasibility of Motor Truck Transportation—Orders Issued to Companies to Use Highways for Drive-Aways

WASHINGTON, D. C., Dec. 29—The motor truck convoy which left Detroit Dec. 14 to make the first test overland drive-away to the Eastern seaboards arrived at Baltimore, its American terminal, yesterday. One of the 30 trucks starting the journey failed to finish, having been struck by a train en route. The trip marks the beginning of a new era of huge and vast drive-aways. Orders were issued immediately following the end of the journey by Major Miller to all motor companies shipping war trucks east to utilize the highways of the nation for drive-aways in all instances. The journey was made slowly under orders from the War Department, averaging 50 miles a day.

The complete convoy comprised 28 3-ton Packard motor trucks, 2 Packard oil tank trucks, a Dodge 5-passenger car, a Dodge roadster, a Dodge light delivery truck and a General Motors light ambulance truck. The personnel included: Capt. Bennett Bronson, Quartermaster Corps, in charge of convoy; Lieut. C. A. Riley, Quartermaster Corps, in charge of motor train; Lieut. L. J. Ward, U. S. M. C., medical officer in charge; eight National Army men; Capt. E. B. Butchers, representing U. S. Engineers Corps, and H. C. Ostermann, representing Highways Transport Committee.

The trip is particularly remarkable in view of the fact that none of the drivers has ever driven any truck before. They were all men taken from an infantry camp and placed at the wheel. Weather conditions were the most adverse possible. The convoy left Detroit at 4 below zero and fought through snow all the way up to Pennsylvania. Schools were let out along the route, business, military and professional men turned out to give welcome to the trucks and the Red Cross had hot meals ready for the soldiers at every stop.

The trip absolutely proves the feasibility of motor truck transportation in all kinds of weather. Following is an outline of the journey:

The U. S. Motor Transport left Detroit Dec. 14 at 10 a. m. from the Packard factory, proceeding through Detroit without difficulty as the streets were cleared of traffic and no deep snow was found. The transport arrived at Monroe, Mich., at 9 p. m. after laying 3½ miles west of Monroe 3 hours attempting to clear the route of snow. The distance covered the first day was 45 miles.

The transport arrived at Toledo at 5:30 p. m. without encountering any particular difficulty between Monroe and Toledo with the exception of short stretches where the road had not been dragged and light traffic had broken the drifts into a zig-zag line. No effort had been made by county officials to scrape off the roads. In many instances the road was broken on one side, covering a portion of the shoulder of the road, making it dangerous to heavy truck transportation. Distance on the second day 18 miles.

They left Toledo 7:30 a. m. Dec. 16, passed to Norwalk, Ohio, and arrived at 7:30 p. m. No effort had been made by the county and township officials to clear the roads and considerable snow drift trouble was encountered. The mileage of the day was 62 miles.

Leaving Norwalk at 8:20 a. m. Dec. 17, the convoy found the road, with a few exceptions, well cleared of snow and experienced no difficulty in reaching Cleveland at 6 p. m., covering 58 miles for the day.

It left Cleveland at 9 a. m. Dec. 18 and arrived at Ravenna, Ohio, at 5 p. m. The road showed some care but work had not been completed in an intelligent manner and many high centers were encountered. From Ravenna to Warren through misunderstanding the route was changed and 24 miles of bad roads were encountered. Later it was learned that officials had cleared the road on the original routing. Trucks arrived at Warren at 3 a. m., covering 65.5 miles.

On the route from Ravenna to Warren truck No. 21 was struck by a passenger train and the driver was killed. This necessitated laying over at Warren on Dec. 19.

The party left Warren at 7:15 a. m. Dec. 20 and arrived at New Brighton at 8 p. m., covering 54.8 miles. Considerable difficulty was encountered on that section of the road known as the "cut-off" between New Springfield and Unity. A little graveling had been done by Mahoning county and nothing at all by the Columbiana county. The stretch was narrow and a primitive dirt road. Three sharp right angle turns were found. After the trucks passed over the road, ruts a foot deep were left.

New Brighton was left at 8:20 a. m. and Pittsburgh reached at 2 p. m. Dec. 21. No difficulty was experienced over this 32 miles of the trip.

From Pittsburgh east the journey was made without difficulty, road conditions in Pennsylvania and Maryland being found in excellent shape.

Credit is given by members of the party to the State Highway Departments of Pennsylvania and Maryland for the remarkable condition of all roads. The last 232.9 miles were made in 7 days.

The trip was educational and resulted in a conference in Washington with the War Department about the lessons learned on the trip. The success of the trip is indicated by the fact that 6 similar truck trains have been ordered to leave Detroit next week, carrying supplies to the seaboard.

The snow organization was bad in Michigan and Ohio, but excellent in Pennsylvania and Maryland. The Highway Transport Committee would like all highway departments to remember that motor truck trains of this kind demand a wider clearance of the roads than passenger cars.

Europe's Post-War Models

Fiat, Renault, Berliet and Others to Get Into Large Production on Medium-Priced Machines

PARIS, Dec. 10—Reports of huge after-war schemes in French motor circles have been prevalent for a long time, but few definite announcements have been made. Now comes the news that the Berliet company of Lyon, France, has formed an auxiliary company, with a capital of $5,000,000, with the intention of building and putting on the market a popular automobile, to be built in series of 30,000 and sold complete at $1,200.

No official announcement has been made regarding the type of car, but it is well known in automobile circles that Berliet has closely studied American production methods, that he has had in hand all the popular American cars, and that experimental models on these lines have been built. Thus it is safe to assume that the $1,200 car will be a six-passenger touring model with electric lighting and starting. It is obvious, too, in view of European taxation and gasoline cost, that it will have a small, comparatively high-speed four-cylinder motor.

While not the biggest in Europe, the Berliet factory, located at Lyon, is recognized as one of the most modern in France. Marius Berliet, the proprietor and founder of the firm, is a self-made man who got into the automobile business in 1899 with three workmen and a capital of $900. Before the war the factory covered 720,000 sq. ft., employed 2000 workpeople and produced 3000 cars a year. The works have grown enormously since 1914, the number of workers now being about 8000. For some time Berliet has specialized on trucks, and thus has kept his works on automobile production during the war. An additional factory is to be erected for the production of the popular after-the-war model.

There are several other firms capable of carrying out a program as big as that announced by Berliet. Fiat Co. at Turin, Italy, for instance, could certainly produce between 40,000 and 50,000 cars a year if the whole of the present factory were concentrated on one model. This company, which claims to be the biggest automobile concern in Europe, has a factory area of 5,400,000 sq. ft., a staff of 25,000 workpeople, and a nominal capital of $10,000,000. In addition it has recently absorbed the Ferriere Piemontesi Steel and Iron Foundries, Rolling Mills, etc., with a capital of $1,800,000; the Officiene Gia Fili Diatto (Tramways and Rolling Stock Works), with a capital of $800,000, and The Industrie Metallurgiche Torino Steel and Iron Works, with a capital of $800,000.

Fiat has not made any announcement of its post-war program, but is already putting out for war service five-passenger cars built on American lines complete with electric lighting and starting. Like Berliet, Fiat has kept on automobile work throughout the war. The Ital-

ian factory has taken advantage of war conditions to make itself independent of all outside concerns; thus it is producing practically every part of its cars, including electric appliances, but excluding magnetos in its own factories. It is reported that even magnetos will be Fiat produced after the war. Fiat has also developed the practice of building a large number of its own machine tools and special factory machinery.

In addition to Fiat there is in Turin a branch concern known as the Fiat San Giorgio, interested in Diesel motors, submarines, aviation motors, etc. This was originally a part of the main Fiat company, but during the past year the Fiat San Giorgio has secured financial independence.

Another firm expected to play an important role in the after-war competition is Renault, of which Louis Renault is the sole proprietor. This factory is now the biggest in France, with a staff of rather more than 20,000 workpeople, engaged on aviation motors, trucks and staff cars. Louis Renault, who started in the automobile business in 1898, in partnership with his two brothers, now dead, and a staff of about half a dozen workpeople, understands American production methods better than any other man in France, for he has made a number of visits to the United States and closely studied automobile conditions there. Up to the war, however, he had refused to break away from the European plan of building a variety of cars to suit the various classes of society. Rumor has it that Renault will put his big factory on the production of one or two popular models to be sold at a popular price. Only one man knows whether this is so or not—and Louis Renault is not talkative.

Reports are busy around the name of Citroen & Co., a firm which before the war made a specialty of gears and gear cutting, not only for the automobile industry but for general engineering. This factory has grown until the staff employed is about 15,000, and if reports can be believed Citroen will make a bold bid in the automobile business.

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More Liberty Contracts for General Motors

DETROIT, Jan. 2—It is understood that the contracts for Liberty airplane engines now held by the General Motors Corp., and being filled by the Cadillac and Buick companies, have been extended. It is stated that these two companies have received new contracts which call for the completion of 50 Liberty engines a day for an indefinite period. The original order was for 1000 engines.

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Women Taxicab Drivers

SEATTLE, Dec. 24—The Seattle Taxicab & Transfer Co. has employed 20 women as taxi drivers, to replace men who have joined the army. More women will be employed as vacancies occur. The new drivers will take the city examination and will be admitted to the Auto Drivers' Union.

Gasoline Allowance Cut in France

11 Gallons Per Month Allowed —Taxicab Use Restricted— Used Cars Drop

PARIS, Dec. 8—With the first day of January French motorists are to be deprived of all gasoline supplies and will receive no more permits to travel, thus making it impossible for them to use up any stocks they may have collected. The maximum gasoline allowed per month will be 11 gallons. This is the summary of a decree issued this week by the authorities and published in the *Journal Officiel*. The new decree puts France on the same footing as England and Italy, where for a few months private motoring has been forbidden. The situation of France is likely to be worse that that of England, for car owners in the latter country have found a certain measure of relief in the use of coal gas carried in rubber containers. This is not possible in France owing to the shortage of coal.

While the general principle of the decree is a complete cessation of motoring, it has been necessary in the interest of the nation to make certain exceptions. Thus the prefects are authorized to issue gasoline cards to persons running public service vehicles or doing work of national importance. This will cover doctors, farmers, business men whose business is necessary to the public, and public officials. It is obvious, too, that there must be a certain number of automobile owners who are completely dependent on the use of an automobile and could not exist without a car or some other means of locomotion. These cases will be considered on their merits, but the maximum amount of gasoline to be allowed in each case is fixed at 11 gallons per month. Up to a few weeks ago the allowance for private motorists was 66 gallons per month.

Ever since the war it has been necessary to have permit to travel by automobile in France. The deliverance of these permits, however, was a mere formality, and in the absence of police on the roads the official piece of paper was not even necessary. With the new year the travel permits will be entirely parochial, so that no automobile owner can get beyond his own immediate neighborhood. Further, the permits to purchase gasoline and the permits to travel will be given out together, a control being kept over the two, thus preventing gasoline being obtained by fraudulent purposes or the use of stocks which have been got together in normal times.

For long-distance touring the same regulations will apply, the authorities issuing the pass when they consider the journey is necessary in the national interests, or is made to transport sick or wounded. A clearly defined route must be followed, and the home trip must be made within a month.

The immediate result of these regulations will be to bring down the price of second-hand cars from the giddy heights they have attained to a more reasonable basis. As an indication of the exaggerated prices a used Rolls-Royce touring car changed hands a few days ago at $9,000, while all the cars discharged from the army as unfit for further war service have been sold to the public at very high figures.

There must be several thousands of small manufacturers and factory owners whose businesses have grown to such an extent that they now find it necessary to use an automobile. Many of these are old touring cars converted to light trucks, which are being worked to destruction with the maximum load on the body and a trailer in the rear. These men must either have gasoline or must limit their activities. It remains to be seen how the Government officials will take care of such cases. There is certainly a wide difference between the liberality of 1916 and 1917 and the proposed restrictions of 1918.

Taxicabs are to be given a special allowance of gasoline,, but they cannot be taken more than 3½ miles from the district in which they are licensed. Thus, in the case of Paris taxicabs, it will be impossible to go more than 3½ miles beyond the city walls.

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Gasoline Exports Drop

WASHINGTON, Jan. 3—Exports of gasoline from the United States fell off approximately 24,000,000 gal. during the first 11 months of 1917 as compared with the same period in 1916. Exports of lubricating oil on the other hand increased nearly 27,000,000 gal. Crude oil fell off about 11,000,000 gal. Following are the figures:

Nov. 1917	11 mos. 1916	11 mos. 1917
Gasoline, Gal.		
56,996,017	332,105,215	308,917,887
Lubricating Oil, Gal.		
25,145,639	244,284,558	271,733,613
Crude Oil, Gal.		
7,444,253	158,534,638	147,942,870

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German Plot Injures War Trucks

WASHINGTON, D. C., Dec. 29—What is claimed to be a German plot was discovered by the War Department, in the injury of 600 war trucks recently ordered and delivered to this city. Upon reception of the trucks they were subjected to the usual examination. Pistons were found to be slightly out of plumb and they were sent back to the factory for correction. They returned with a slight knock, and an investigation by the secret service revealed that a German foreman who headed the machine shop where the trucks were had contrived to put them out in defective condition.

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Stutz Engines—Correction

The Stutz Motor Car Co. manufactures only cars with 4-cylinder, 16-valve engines, and an item to the contrary in AUTOMOTIVE INDUSTRIES of Nov. 29 was incorrect.

Curtiss Bond Issue of $15,000,000

To Simplify Advances from Government and Retire Present Outstanding

BUFFALO, Dec. 30—The Curtiss Aeroplane & Motors Corp. will issue $15,000,000 of first mortgage 6 per cent bonds, in 6 series, on Jan. 1. This is to simplify the process of securing advances from the Government through the War Credits Board, which are to be made for assisting its production on war contracts.

Series A, of $359,000, maturing Jan. 1, 1919; Series B, of $356,000, maturing Jan. 1, 1920; Series C, of $348,000, maturing Jan. 1, 1921; Series D, maturing Jan. 1, 1922, and Series E, of $1,982,000, maturing Jan. 1, 1923, will be used to retire, on a dollar-for-dollar basis, the present outstanding 6 per cent notes and the gold 6s of 1927. With the shortened maturity, no difficulty is expected, especially as the new notes, like the old, are convertible into common stock at $50 a share, and callable at 102½.

Series F, not convertible, and redeemable at par, is neither to be issued nor sold, but deposited with the Government as collateral against the expected advance upon contracts, in order to provide the "proper security" required by law in case of a Government advance. Officials of the company explain that the entire plan is not, strictly speaking, a new financing operation, but is merely intended to simplify the company's financial position in respect to the funded debt, preparatory to the Government's advance on contracts. This advance became necessary to give the company a free hand and plenty of working capital for the near future, as the labor of financing its new plant had imposed a heavy strain upon the company's resources.

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Reo Shipping 125-150 Cars a Day

LANSING, MICH., Dec. 31—Daily shipments of the Reo Motor Car Co. average from 125 to 150 cars and many of these are being driven overland by dealers. Part of these cars are being taken by the dealers and stored at points near Lansing in the hope that the freight car situation will ease up slightly and permit them to be shipped to their ultimate destination. When and wherever possible drive-aways will, however, be used.

The Reo Motor Car Co. is tooling up preparatory to the manufacture of tractors for the United States Government. It is stated that this work will not materially reduce the production of the Reo company, as it works in nicely with the equipment and labor at hand. Hence the Reo dealers throughout the country will suffer no particular hardship. There are at present about 3500 cars on hand ready for transportation providing the equipment were available and officers of the company state that the recent Government control of railroads will doubtless better the freight car situation. This will be particularly due to the fact that any particular railroad equipment may be sent in any desired direction when needed—a condition that has been impossible in the past.

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Kissel Released from B Truck Contract

WASHINGTON, D. C., Dec. 29—The Kissel Motor Car Co. has been released from its contract for 500 Class B heavy duty war trucks because of its need for all facilities to handle more recent contracts for four-wheel-drive trucks. The contract for the 500 B trucks was transferred to the Garford Motor Truck Co., making the Garford contracts for B trucks total 1000. It is rumored that two or three other concerns will also be released from their contracts.

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Lang to Build Bodies

CLEVELAND, Dec. 27—The Lang Body Co. is completing its building and expects to start production by Feb. 1. The first unit, a three-story, L-shaped building of mill construction and the dry kiln is practically finished. The work is about thirty days behind schedule due to unusual weather conditions.

The company now has in stock lumber, aluminum and steel for the manufacture of commercial and passenger car bodies. The plant occupies five acres of land on the switch of the New York Central near West 106th Street and has an option on five adjoining acres. The officers of the company are: President and treasurer, Charles E. J. Lang, formerly vice-president and treasurer of the Rauch & Lang Carriage Co., and later vice-president and director in the consolidation of the Rauch & Lang Carriage Co., and the Baker Co.; vice-president and general manager, Elmer J. Lang; secretary, John H. Price. L. L. Williams, formerly with the body department of the Peerless Motor Car Co., is engaged in similar work in the Lang company.

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New R. & L. Electric Model

CLEVELAND, OHIO, Dec. 31—The Baker R. & L. Co., manufacturers of the Rauch & Lang electric car, has developed a new model chassis styled W-42. This has a wheelbase of 142 in. and new body design. The construction is practically the same with several improvements incorporated including a more powerful motor. Three body styles are offered, a touring car, sedan and limousine.

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Monroe Lowers Its Prices

PONTIAC, MICH., Dec. 31—In spite of the continually increasing cost of material the Monroe Motors Co. is decreasing the price of its product for 1918. The model N-6, four-cylinder touring car, previously cost $1,095 and this has been reduced $100 for the coming year. The sedan body, mounted on the same chassis, sells for $1,850. The reason stated for this decrease is that an increased production renders the reduction in price possible.

Truck Makers Try Drive-Aways

J. C. Wilson Co. and Dodge Will Follow Policy All Winter

DETROIT, Jan. 2—Truck manufacturers are following in line with passenger car manufacturers and using the drive-away method of getting trucks into dealers' hands. The J. C. Wilson Co. is having drive-aways to cities as far away as Boston, Philadelphia and Baltimore. Members of the firm say that in spite of road conditions saving in time and expense is considerable, even though freight car equipment were available.

Careful records of the last drive-away to Baltimore were kept. Each truck, of the 2-ton type, carried parts for the Baltimore service department. The distance of 543 miles was covered in 4 days, via Toledo, Cleveland, Youngstown, Pittsburgh, Uniontown, Cumberland and Baltimore. The average number of gallons of gasoline consumed was 52, with 1 gal. of oil. The total expense per truck, including insurance and mechanical wear proportional to yearly overhead, was $62.91; the cost per day, $15.56; the mileage cost, 11.6 cents, and the ton-mileage, 5.8 cents.

Dodge Brothers are likewise delivering their new commercial car overland, and this policy will be followed all winter, regardless of weather conditions. Already cars have been delivered to Lawrence, Kan.; Atlanta; Hannibal, Mo.; Paris, Tenn.; Waterloo, Iowa; Cincinnati; Davenport, Iowa; Johnstown, Pa.; Terre Haute and Chicago.

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Jones to Have Continental Engine

WICHITA, KAN., Dec. 27—Jones cars and trucks will have Continental engines. A contract has been signed, by which the Continental Motor Co., Detroit, will supply engines for the new 27 A-B-C series and the 1 and 2-ton trucks. Model 26 A-B-C will continue with the Lewis engine.

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Maxwell Preparing for Government Work

DETROIT, Dec. 31—The Maxwell Motor Co. is taking on tool designers, tool makers and die makers, and otherwise preparing for filling the Government contracts which it now has on hand. Due to the large amount of Government work at present being placed in production there is a premium placed on this class of skilled labor and it is difficult to obtain it even then.

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Government Work for McFarlan

INDIANAPOLIS, IND., Dec. 31—The McFarlan Motor Car Co., Connersville, has signed a contract with the Government for the manufacture of 6,000 automobile tool chests. Officials of the company state that the order will keep the plant in operation to full capacity for several months.

France to Receive 1500 Tractors

Will Plant 1,500,000 Extra Acres of Wheat and Potatoes

WASHINGTON, Jan. 2—Fifteen hundred farm tractors will be sent to France by the Food Administration. All will be over-seas for spring plowing in March. It is estimated that this increase in the French food supply, through greater efficiency, will release 2,000,000 tons of shipping in 1918 that otherwise would be needed to transport food. France in 1917 had 30,742,157 acres of crops, compared with 40,657,293 in 1913. The total food crop in 1917 was 24,581,290 tons as compared with 30,462,340 tons in 1913. The tractors will enable the French to plant 500,000 additional acres of potatoes and an extra million acres of wheat.

The plan for sending the tractors was conceived by Henry Morgenthau and his son, Henry Morgenthau, Jr., the latter of whom will supervise the delivery of the tractors in France and establish schools to train older men and women to use them. The French government has accepted them and they will be distributed by the French Minister of Agriculture. The National Implement and Vehicle Association approved the plan and gave assurance that it would not interfere with American farm production.

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Washington Has New Car Licensing Law

WASHINGTON, Jan. 2—Washington's new motor car law, providing for the yearly licensing of cars, which was enacted by Congress last session, went into effect Jan. 1. Motorists will have the entire month of January in which to procure their numbers, owing to the inability of the officials to secure numbers fast enough. The new registration law bases the tax on horsepower and the S. A. E. rating has been adopted. The rates are: 24 hp. and under, $3 per year; 30 hp. and less, $5; over 30 hp., $10; demonstrating cars of dealers, flat rate of $6 each; motorcycles, $2. Heretofore the tax was $2 per car and was good as long as the person to whom it was issued owned the car. Maryland is the only state in the union that has no reciprocity agreement with the District of Columbia. Motorists in that state will be compelled to take out licenses here if they desire to come into the District of Columbia.

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Goodyear Profits Increase 100 Per Cent in 1917

NEW YORK, Jan. 2—Last year was the most successful in the history of the Goodyear Tire & Rubber Co. Gross sales jumped from $63,000,000 in 1916 to $111,000,000 in 1917 and net profits from $7,003,330 to $14,044,206. This shows an increase of 74 per cent in volume and 100 per cent in profits. Of this amount less than 1 per cent resulted from war business. The plant capacity of the company was almost doubled during the year.

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Reilly Goes with Globe

SAN FRANCISCO, Jan. 2—W. P. H. Reilly, Pacific Coast sales manager of the Ajax Rubber Co., has resigned to become special representative of the Globe Rubber Tire Mfg. Co.

This change followed when J. C. Matlack accepted the presidency of the Globe Co. Reilly has been associated with Matlack for many years.

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To Make Reversing Oil Engine

MILWAUKEE, Dec. 31—The American Oil Motors Co. is being organized with a capital stock of $1,000,000 by members of the Corporation Finance Co., 309 Caswell block, to manufacture an internal combustion engine designed by Charles S. Salfeld. This is capable of using the heaviest oils and distillates as fuel. The engine is designed for application to all kinds of vehicles, tractors and airplanes and is a reversing type. A. C. Lingelbach, Milwaukee, is handling the details of the promotion.

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50 Trucks Overland from Buffalo

BUFFALO, Jan. 1—Fifty Pierce-Arrow army trucks left to-day overland for New York. This is the largest convoy ever started out in this way. The convoy of trucks which recently went from Michigan to Baltimore numbered 30. The first truck is fitted with a snowplow and the engineers were fitted out with winter clothing by the Buffalo Red Cross. Captain J. D. K. Loach, Twentieth United States Engineers, is in charge of the trucks and the 92 men who operate them.

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Syracuse Plant for Smith Wheel

SYRACUSE, N. Y., Dec. 31—The Smith Wheel, Inc., will increase its capital from $100,000 to $3,000,000 and take over the Globe Malleable Iron Co. The latter is the oldest manufacturing plant in Syracuse. Both companies are working on war orders.

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Carrell Appointed Chief Engineer

SAGINAW, Jan. 2—William A. Carrell has been appointed chief engineer and works manager of the Erd Motor Co., Saginaw. He will also direct the sales and advertising. Formerly he was associated with the Wisconsin Motor Co., Milwaukee, and general superintendent of the Beaver Mfg. Co. and superintendent of the Milwaukee plant of the International Harvester Co.

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Sweet Is Captain in Aviation Section

GRAND RAPIDS, Jan. 2—George P. Sweet, manager of the United Motors Co., Grand Rapids, has been commissioned a captain in the aviation section of the signal corps.

Detroit Feels Need of Specialists

But Shortage of Highly Skilled Men Will Not Seriously Hamper Production

DETROIT, Jan. 3—As has been the case for some months, there is a scarcity of what might be called specialist labor in Detroit, by this being meant such artisans as tool designers, tool makers, die makers, gage inspectors, time study experts, factory layout men, and chief inspectors. Although there is a scarcity of these specialists there is no danger of this condition delaying war materials getting into production. Chester M. Culver, manager of the Detroit Employers Association, an organization handling 225 Detroit concerns, states that there will not be any delay on production due to these causes.

It is these men who make the tools and equipment necessary for the production of all war materials, but after these tools are made comparatively unskilled labor can be used in the actual production. From that time on a small force of skilled men is required to keep the supply of tools, jigs and fixtures up to normal, and the others can be released for subsequent tool making.

The Government is taking many of these skilled laborers directly into their arsenals. Recently representatives were here from Watervliet, and to-day several were here from Rock Island, Ill., for the same purpose. The Government furnishes the gages, etc., for the manufacturer of munitions, and these representatives complain that unless they get men the work on the actual contracts will be greatly delayed, as that work cannot go ahead until the gages and fixtures are at hand.

At present every tool shop in the city needs tool makers, and practically all the manufacturers are advertising and desiring the same kind of labor. The statement that this kind of labor is not to be permanently required is demonstrated by the fact that the Rock Island arsenal representative does not desire these men for more than 2 or 3 months, and suggests that their families be left in the city, for after that time unskilled labor can take up the work and carry on the production.

Culver states that the building trades will supply many men for production work, as these trades are very quiet today. In their own field these men are experts, and hence readily pick up the small amount of training required in manufacturing munitions. Dilution of labor will relieve the problem once we are in production. This simply means that unskilled men and women will be trained to do one part of the production work in an expedient manner, the skilled workmen being used to check up the work and keep the tools in order.

It is stated that Frank E. Vanderlip's talks and newspaper articles did not take this fact into consideration, for an im-

mense amount of the production can be done by unskilled labor and skilled men are only needed to prepare the tools and later a few to maintain the equipment, but more time will be required to get into the actual production, because of this scarcity of skilled labor.

Many thousands of workmen will be needed in the city. It is estimated that Dodge Brothers' plant will require from 8000 to 10,000 men, that of the Lincoln Motors will require from 5000 to 7000 men and women, and the Detroit Shell Co., the Fisher Body Co., the Packard Motor Car Co., the Cadillac Motor Car Co. and the Maxwell Motor Co. will require many thousands more. But once in production by the dilution of labor the situation can be satisfactorily handled.

Northway in New Vehicle Company

BOSTON, Jan. 4—The Northway Motors Corporation has just been formed here and has secured a charter from the State to manufacture cars and trucks. R. E. Northway, formerly head of the Northway company of Detroit, that made motors, transmissions, rear axles, etc., and was taken over by General Motors in 1909, has come East to be chief engineer. Senator James E. Cavanagh is president; James E. Finneran, head of a big drug company, is treasurer, and some men prominent in other lines comprise the board of directors. The company has been incorporated for $5,000,000. The plant will be located in Boston.

Another Motor Mail Route

LOUISVILLE, Jan. 2—An automobile mail route will be established between Cave City, Ky., and Louisville. It previously has been announced from Indianapolis that a similar route from Louisville to Indianapolis would be established. This plan is being tried out by the government to enable farmers to market their perishable and other products. If these routes prove successful the system probably will become universal throughout the country. By Feb. 14 the routes will be ready for business, it is thought.

From Louisville to Cave City is a distance of 88.8 miles. An automobile will leave Louisville and Cave City at 5 o'clock each morning except Sunday and will have reached its destination by 2 o'clock in the afternoon. The Dixie Highway will be traversed and the following towns reached on the Cave City route: Shively, West Point, Elizabethtown, Upton, Bonnieville, Munfordsville, Rowletts and Horse Cave.

Towns which the route between Louisville and Indianapolis will pass through include New Albany, Bennettsville, Borden, Salem, Vallonia, Brownstown, Seymour, Janesville, Columbus, Taylorsville, Edinburg, Franklin and Greenwood.

Daily trips between Louisville and Indianapolis are planned. The automobiles will be "post-offices on wheels." One will leave each of the two cities at 4.30 o'clock in the morning and reach its destination at 6 o'clock in the afternoon.

Postmaster Schmitt will accept bids for carrying on the work under government contract.

G. M. Earnings Are $12,900,000

Represent 4 Months Profits and an Increase of 43.4 Per Cent Over That of 1916

NEW YORK, Jan. 2—During the 4 months ended Nov. 30, 1917, the General Motors Corp. earned undivided profits of $12,900,000. This compares with $8,993,633 in the same period of 1916, an increase of $3,906,367, or 43.4 per cent. This figure of profits, after allowing for proportionate preferred dividends, but before allowing for war taxes, amounts to 15.1 per cent on the $82,500,000 common stock outstanding for the four months' period.

No official estimate will be available for General Motors war taxes until further rulings are made, but in entirely unofficial quarters taxes are estimated at a maximum of $8,000,000 per annum, which for the four months' period would work out about 3 per cent on the common stock. On this basis of calculation, General Motors in four months, after proportionate taxes and preferred dividend requirements, earned a surplus equal to 12.1 per cent on the common stock.

Sales in the four months ended November amounted to 72,923 cars and trucks against 52,868 in the same period of 1916. Net sales for the period were $74,868,000 against $48,383,997.

Cash in the bank and sight drafts with documents attached as of December 18, 1917, amounted to $23,530,000.

Comparison of results for the four months ended November 30, 1917, with the corresponding period of 1916 follows:

	1917	1916	Increase
Cars & trucks sold	72,923	52,868	20,055
Net sales..	$74,868,000	$48,383,997	$26,484,003
Undivided profits ..	12,900,000	8,993,633	3,906,367

Navarre to Attempt Flight Across Atlantic

PARIS, Dec. 22—Jean Navarre, who, until his mad exploits which brought him in contact with the Paris police, was the best aviator France possessed or ever had possessed, has just announced his intention of making a flight across the Atlantic. For several months now Navarre has been in disgrace. After his foolish escapades in Paris he was brought before the military courts, where it was pleaded that he was not in full possession of his mental faculties, the solution of the matter being his discharge from the army. According to *l'Echo des Sports*, in which journal Navarre has confided, the famous aviator is completely cured of his youthful wildness and is determined to retrieve his reputation.

In the present stage of aviation a flight across the Atlantic is just within the range of possibility, but the risks are so great that it needs a man of the daring and audacity of Navarre to make the attempt. Two methods are possible: A fast, light, scout type of machine capable of an average speed of more than 125 miles an hour; such machines exist; and a big slow machine, of the Handley Page, Gotha, or Caproni type, averaging between 80 and 90 miles an hour.

Navarre is in favor of the latter type of machine, which he considers should be fitted with four engines of 300 hp. each, and should carry three men, who will be both pilots and mechanics.

The shortest route across the Atlantic is about 2500 miles, thus with an 85 miles an hour machine the flight would last 30 hours, and each of the three men would undertake two periods of piloting of five hours each. After the first 5 hours at the wheel, the pilot would look after the engines for 2½ hours, then rest for 7½ hours, and at the end of this time would take his place at the steering wheel.

The weight of the machine, with supply of fuel, oil and provisions for a flight of this length is estimated at 12 tons. It is intended, at the outset, to use all four engines. At the end of ten hours, when the consumption of fuel will have reduced the total weight to 9 tons, it is intended to run with three engines, thus maintaining the same average speed with a lower consumption of fuel. At the end of another ten hours, when the weight will have reduced to 6 tons, a second engine will be stopped, and the flight finished with two engines only, developing 600 hp.

The machine will be a biplane hydroplane with two of the motors carried in the fuselage and one each to the left and right, on the wings. The bearing surface will be more than 3000 sq. ft., the wing span about 108 ft.

Louisville Show Abandoned

LOUISVILLE, Jan. 2—No show will be held this winter under the auspices of the Louisville Automobile Dealers' Association. This was decided last week at the annual meeting of the organization after carefully considering a committee report that the First Regiment Armory could not be obtained, as it is being used for government purposes. There is no other building in the city suitable to house an exhibition of such magnitude.

The following officers were elected to serve during the coming year: Prince Wells, president; W. A. Thomas, vice-president, and Philip S. Longest, secretary.

Jordan Earns at Rate of 66 Per Cent

DETROIT, Jan. 3—The statement of the Jordan Motor Car Co. for the quarter ending Jan. 1 shows an increase of 30 per cent in the number of cars sold, compared with the corresponding period last year. Net car sales for the last quarter of 1917 totalled $571,232. Sales of parts amounted to $19,593. The cost of cars amounted to $500,746. The total cost of doing business was $540,524. The net profit was $50,302.55 and the total income $590,826. This represents 16.7 per cent on $300,000 preferred capital for the quarter at the rate of 66 per cent for the year.

New York Exports $9,481,394

November Shipments to Allies Largest Factor—England Gets 971 Trucks

NEW YORK, Dec. 27—Exports of passenger cars, trucks and parts from this port for November totaled $9,481,394. This includes shipments of 1403 passenger cars, valued at $3,844,194, and 1403 commercial vehicles and motor trucks valued at $3,446,072. The value of parts exported was $1,921,595.

Russia was the largest purchaser of passenger cars, 202 cars valued at $454,781 being shipped there from New York. Australia's purchases rank second and amount to 551 cars valued at $437,310. The average value of the car sent to Russia is 3 times as great as that sent to Australia. England leads in the number and value of trucks exported, having purchased 971 commercial vehicles and motor trucks valued at $2,316,478. France ordered 106 trucks at $297,146.

Our shipments to the Allies were by far the largest factor in export trade from the port of New York. These amounted to $4,598,819. The next largest customer was South America, whose bill was $1,286,310.

$1,000,000 More Taxes from Motorists?

BOSTON, Dec. 29—A plan to collect $1,000,000 in taxes from Massachusetts motorists to replace a similar amount appropriated for road maintenance, but needed for other Government expenses, was given wide publicity yesterday. A short time ago a commission appointed to raise revenue told the Highway Commission that the commonwealth was in need of more money, and that $1,000,000 of the amount held by the commission for road maintenance should be turned into the state treasury and an extra tax of $5 per vehicle and $3 on operating fee be collected to make up the loss. The commission pointed out that the money had been appropriated for road maintenance and could not be used for anything else. The Boston Automobile Dealers' Assn. called together the heads of all motor organizations and a letter of protest against the passing of such a law was sent to Governor McCall, who, it is understood, plans to embody the suggestion of the Revenue Commission in his annual message to the legislature on Jan. 2.

Detroit Shell Co. Has Option on Springfield Plant

DETROIT, Dec. 28—A meeting of the Springfield Body Corp. and the Springfield Realty Co. was held to-day by the referee in bankruptcy to show a cause of action in the re-sale of the property. The actual sale of the plant of the Springfield Body Corp. has not yet taken place. However, the Detroit Shell Co., recently organized by Detroit automobile makers and financiers, has an option on the plant. At present the affair is pending the action of the Detroit Shell Co.

Automobile, Truck and Parts Exports from New York for November

	Cars (No.)	Value	Trucks (No.)	Value	Parts
Argentine	485	$355,443	2	$1,450	482,913
Australia	551	437,310	36	44,983	103,365
Barbados	3	1,129	....	....	....
Bolivia	5	8,187	....	....	....
Brazil	249	141,308	....	....	45,805
British East Africa	3	2,110	....	....	116
British Guiana	48	30,276	....	....	2,342
British Indies	6	5,755	....	....	17,338
British South Africa	219	174,545	6	17,667	1,499
British West Africa	....	....	4	2,159	196
British West Indies	19	16,241	21	84,770	2,595
Chile	337	417,592	5	13,555	....
China	1	1,492	....	....	77,257
Colombia	13	10,883	....	....	3,789
Costa Rica	1	1,020	....	....	725
Cuba	140	171,464	35	63,045	101,264
Danish West Indies	3	1,095	1	2,150	583
Denmark	....	....	....	....	100
Dutch East Indies	372	338,546	36	103,431	77,257
Dutch Guiana	5	1,825	....	....	....
Dutch West Indies	1	850	....	....	653
Eucador	22	18,926	....	....	1,879
England	123	168,675	971	2,316,478	568,974
France	17	201,884	106	297,146	469,987
French Africa	1	619	....	....	....
French Guiana	4	1,600	....	....	....
French West Indies	3	2,070	2	5,000	4,311
Guatemala	1	1,625	....	....	207
Haiti	2	1,200	....	....	3,192
Honduras	2	2,075	....	....	380
Italy	4	936	....	....	2,200
Jamaica	14	8,317	....	....	6,857
Japan	4	3,150	1	1,040	625
Korea	1	....	2	1,629	....
Mexico	127	114,148	7	10,795	3,222
New Foundland	3	3,200	....	....	527
New Zealand	295	266,064	10	18,575	683
Nicaraugua	1	710	....	....	25
Norway	1	2,600	....	....	....
Panama	25	12,976	8	12,000	7,214
Peru	37	51,339	2	6,572	3,317
Portugal	5	6,981	4	16,880	853
Russia	202	454,781	77	226,902	100,806
Salvador	3	3,277	....	....	187
Santo Domingo	21	13,231	4	2,999	6,178
Scotland	....	....	55	88,200	....
Siam	....	....	....	....	30
Spain	184	209,085	5	2,057	11,277
Trinidad	22	18,009	3	6,569	10,931
Uruguay	223	132,270	....	....	17,716
Venezuela	14	6,115	....	....	4,435

To Start 4,000-Mile Mail Route

Post Office Department Will Operate Chain of Trucks for Parcels Delivery

WASHINGTON, Jan. 2—The installation of motor truck parcel-post routes in various sections of the country, aggregating between 3000 and 4000 miles, is the plan of the Post Office Department. It is expected these routes will be in operation within the next 3 months. One chain of motor routes will extend from Portland, Me., to New Orleans. Another will cover much of a large stretch of territory in Ohio, Indiana, Illinois and West Virginia. On the Pacific Coast routes will be established between San Francisco and Sacramento, via Stockton and Fruitdale, a distance of 125 miles, and between Redlands and Los Angeles, via Ontario and Pomona, Cal., a distance of 76 miles.

The existing law does not provide for the employment of Government-owned motor trucks on rural delivery routes, nor does it require the rural carriers to use motor vehicles.

In the star route service, however, where the mail is carried under contract, a recent law permits the Post Office Department to designate the kind of vehicles to be employed, and in awarding new contracts the department will specify that motor trucks shall be employed on all routes where the roads are such as to admit of their use. These contracts are advertised for bidders, and where payment asked for the service is deemed to be excessive the department is authorized to provide Government-owned motor trucks and to employ drivers for the operation of these routes.

A further extension of the employment of Government-owned motor vehicles by its adoption for the parcel post service of the rural routes will be made whenever Congress enacts a law now pending for that purpose.

Expect Advance Rumely Profits Increase

LAPORTE, IND., Dec. 27—It is expected that profits of the Advance Rumely Co. for 1917 will be 30 to 50 per cent greater than in 1916 when the company earned $278,478. With the prospects of a record year for agricultural products throughout the country, the company is preparing for a bigger year than 1917, and in addition is trying to get government work to keep its plants up to their full capacity.

Fiat Absorbs Three Companies

TURIN, ITALY, Dec. 23—The Fiat Co. has absorbed three companies. They are: Ferriere Piemontesi Steel and Iron Foundries, capitalized at 9,000,000 liras; Officiene Gia Fili Diatto Railways and Trams Rolling Stock Works, capital 4,000,000 liras, and Industrie Metallurgiche Torino Steel and Iron Works, capital 4,000,000 liras.

Kliesrath Leaves Bosch—Buys Interest in Simms Co.

EAST ORANGE, N. J., Dec. 29—Victor W. Kliesrath, for many years chief engineer of Bosch Magneto Co., has acquired an interest in the Simms Magneto Co., East Orange, and after Jan. 1 will devote his entire time to the business in the capacity of consulting engineer. It is probable that new types of magnetos not made now by the Simms Magneto Co. will be added to complete a line of ignition equipment to meet every requirement. New types of interest will soon be announced.

A. C. Barber has been appointed division manager for the Willys-Overland Co. with headquarters in Moline, Ill. R. L. Butler is sales manager and has been transferred from Toledo to Moline.

C. R. Clough has been appointed sales manager of the Stephens Motor branch of the Moline Plow Co., with headquarters in Moline. He was formerly eastern district sales manager, and this position will be filled by his assistant, J. F. Hunter.

George M. Ellis and **W. C. Dudgeon** have joined preparatory classes for the ordnance department at Ann Arbor. Both were connected with the Campbell Ewald Advertising Agency. L. W. Chamberlain, of the Carl M. Green Advertising Agency, is planning to join them.

Ferris B. Fick, purchasing agent of the Saxon Motor Car Co., has resigned to become purchasing agent for Chalmers material at the Maxwell Motor Co., Detroit plant.

C. J. Pomeroy, formerly in charge of the operating department of the Seattle branch of the B. F. Goodrich Co., has received the commission of captain in the United States Army. He will be stationed at Camp Lewis.

Gregory Flynn, for seven years sales manager of the Rajah Auto Supply Co., Bloomfield, N. J., has been appointed assistant to the president of the Edward A. Cassidy Co., New York.

C. J. Elston, service manager of the Saxon Motor Car Co., Detroit, has resigned to become sales representative of the Asbestos & Rubber Works of America, New York.

C. T. Dunkle, formerly manager of the Columbus branch of the Willys-Overland Co., has organized a $100,000 company under the style Overland-Dunkle Co. to take over Overland sales in central Ohio territory.

C. J. Cunningham has been made service manager of the Detroit Weatherproof Body Co. For the past three years he has been working in the factory with this position in view.

Men of the Industry

Changes in Personnel and Position

P. P. Hinckley has been transferred from the sales department of the Connecticut Telephone & Electric Co., Meriden, to the position of purchasing agent of the company.

Wetmore Hodges has been elected vice-president and general manager of the Haskelite Co., Grand Rapids.

A. W. Sayre has been appointed district manager of the Willard Storage Battery Co. factory branch at New York. He was formerly in charge of the Willard service station, Rochester, N. Y.

Edwin P. Jones has been made manager of the Brooklyn branch of the Firestone Tire & Rubber Co., to succeed H. A. Lane. Jones has been manufacturers' representative for several Western hardware concerns, and has also been connected with the Philadelphia branch of the Firestone organization.

R. M. Hernandez, for 10 years with the United States Tire Co. in the central States district, has been appointed central district manager of the Carlisle Cord Tire Co., Inc. His headquarters will be at Chicago.

Charles E. Stahl has been made assistant general manager of the Connecticut Telephone & Electric Co., Meriden. He will continue the direction of the sales department.

Raphael Semmes, vice-president of the Semmes Motor Co., Washington, has received a first lieutenant's commission in the Signal Corps. He will probably be attached to the non-flying division of the aviation section.

A. N. Pearson is district representative in the New England States for the Denby Motor Truck Co., and will have his headquarters in Boston.

Roy Coffeen has been made branch manager of the Willys-Overland, Inc., succeeding M. O. Bridgman who for the past 5 years has been branch manager.

G. G. Giese, St. Louis, secretary and manager of the Panama Rubber & Equipment Co., has joined the Quartermaster's Department.

Leonard Veith Passes Away

NEW YORK, Dec. 22—Leonard Veith, secretary of Asch & Co., died yesterday.

McMullen Goes West—To Represent Timken Co.

DETROIT, Dec. 31—George C. McMullen, assistant plant manager of the Metal Products plant of the Timken-Detroit Axle Co., has been obliged to leave Detroit due to the poor health of Mrs. McMullen. He will locate in or near Los Angeles, and will represent the Timken-Detroit Axle Co. and the Timken Roller Bearing Co. on the coast. The Detroit plant with which McMullen has been associated for the past two years has given him an indefinite leave of absence. Previous to the above-mentioned connection he was with the Crane Motor Car Co. of Bayonne, N. J., for five years.

Donald F. Whitaker, sales and advertising manager of the Detroit Truck Co., has resigned.

L. Berry, Chicago, has been transferred to St. Louis as manager of the Ahlberg Bearing Co. branch.

Robert Bron, formerly with the Union Electric Co., St. Louis, has been appointed manager of the Philadelphia storage battery service in that city.

L. A. Sumner, former general factory manager, is now assistant general manager of the Allen Co.

C. L. Allen has joined the Chevrolet Motor Co., having resigned as production manager of the Allen Motor Car Co.

G. E. Draw Mutual Motors Trustee

JACKSON, MICH., Nov. 13—G. E. Draw has become trustee for the Mutual Motors Co., which manufactures the Marion-Handley. He was formerly treasurer. An inventory is being taken and manufacturing has been stopped. The capitalization is $1,000,000, having 500,000 shares of common and 500,000 of preferred.

Oakland Gets 50 Freight Cars

PONTIAC, MICH., Dec. 26—The Oakland Motor Car Co. has obtained 50 new Northern Pacific freight cars for motor vehicle transportation. These are being loaded for immediate passage to Seattle and Portland. Each freight car will carry 5 vehicles.

Packard Starts Trucking Exchange

DETROIT, Dec. 26—The Packard Motor Car Co. has established a Detroit Trucking Exchange, to serve as a truck clearing house. Owners of trucks are listed, and when a company requires an additional truck the exchange is advised and obtains an idle truck. This service, which is performed without charge, will help relieve terminal and warehouse congestion, improve the freight situation and keep material moving.

L. E. Joels has been appointed works manager of the Duesenberg Motors Corp., New York. He occupied a similar position with the Packard company.

Studebaker Government Work Reaches $13,000,000 Mark

NEW YORK, Jan. 2—The Studebaker Corp. is understood to have orders for Government work amounting to $13,000,000 and it is stated that the consummation of these orders may operate to reduce the production of passenger cars to substantially below the 50,000 car mark reached in 1917. The Government work is for such products as escort wagons, water tank wagons, mine anchors and artillery wheels. Both the South Bend and Detroit plants will be utilized for this work.

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Smith Adds to Directorate

CHICAGO, Jan. 2—The Smith Motor Truck Corp. has added the following men to its directorate: P. L. Coonley, vice-president Link Belt Co., Chicago; C. E. Danforth of Van Emburgh & Atterbury; W. R. Dawes, vice-president Central Trust Co., Chicago; O. J. Fehling, manager National Malleable Castings Co., Chicago; D. W. Figgis, president of the company; David R. Forgan, president National City Bank, Chicago, and C. B. Little; J. M. Hoyt, Central Bond & Mortgage Co., Chicago; J. L. Putnam, New York. It is stated that the company has marketed slightly more than 20,000 Smith Form-A-Truck units during the year.

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New Upholstery Material

CHICAGO, Jan. 2—Wilson & Co., one of the largest packers and provisioners in the country, has been granted a patent on a new process of preparing curled hair for use in upholstery. The patent is No. 1,248,066. The new process is one by which curled hair is woven on burlap fabric. With the new product a piece of woven hair cut to dimensions, and of uniform thickness, is used in place of loose curled hair which heretofore has been used extensively. The new product eliminates difficulties with properly upholstering seat cushions and makes impossible any bunching of the hair after the cushion is completed.

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Wisconsin Duplex to Have Oshkosh Plant

OSHKOSH, WIS., Dec. 31—The Wisconsin Duplex Automobile Co., which was organized a year ago with $500,000 capital to manufacture a quadruple-drive passenger and commercial car chassis, has selected Oshkosh, Wis., as the permanent location of its factory and offices. Early in the spring a large machine shop will be erected and the manufacture of chassis undertaken on a large scale. Until then the present experimental shops at Milwaukee will be continued for a regular output of a limited number of cars.

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Changes in Capital

MILWAUKEE, Dec. 29—The W. S. Seaman Co., manufacturer of closed car bodies, has increased its capital stock from $50,000 to $150,000.

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CLEVELAND, Dec. 28—The Hydraulic Pressed Steel Co. has increased its capitalization from $5,700,000 to $7,200,000.

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SAGINAW, MICH., Dec. 27—The Erd Motor Co. has increased its capital stock from $100,000 to $250,000.

Ajax Co. Buys $2,000,000 Greenpoint Plot for Factory

NEW YORK, Dec. 31—The Ajax Rubber Co., Inc., has bought a $2,000,000 plot in Greenpoint, adjacent to the site of the State Barge Terminal, on which it expects to build a factory and warehouse. The property, which consists of several old brick and frame buildings on about 169 lots, has a 900-ft. frontage on the East River and Newtown Creek, and an average depth of 470 ft. The tenants of these buildings have been asked to vacate immediately, and the Ajax company will improve the site as soon as building conditions are favorable.

The plot, which is opposite Twenty-third Street, Manhattan, is known as the "Sugar House property," being formerly occupied by the American Sugar Refining Co. as a refinery, and later as a storage warehouse.

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Cooper Union Adds Engine Course

NEW YORK, Jan. 2—A motor vehicle engineering course has been added to the other night classes at Cooper Union Institute. It will include classroom work and there will be an extensive laboratory course, covering testing materials and engine testing. The course is free and will be conducted by Ethelbert Favary.

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Stanley Hall Dies

BOSTON, MASS., Jan. 3—Stanley Hall of the H. & H. Specialties Co., formerly manager of some of the big tire branches in New England, died here last week after a few months' illness. He was a director of the Bay State A. A. of Boston and active in the accessory trade.

Automotive Securities Quotations on the New York and Detroit Exchanges

	Bid	Asked	Net Ch'ge
*Ajax Rubber Co.	45	50	+4½
*J. I. Case T. M. Co. pfd.	73	77	+1
Chalmers Motor Co. com.	2	4	..
Chalmers Motor Co. pfd.	..	50	..
*Chandler Motor Car Co.	66½	67½	+4¼
Chevrolet Motor Co.	93	95	+17½
*Fisher Body Corp. com.	20	34	..
*Fisher Body Corp. pfd.	70	87½	+2½
Fisk Rubber Co. com.	..	45	..
Fisk Rubber Co. 1st pfd.	98	103	..
Fisk Rubber Co. 2nd pfd.	60	70	..
Firestone Tire & Rubber Co. com.	95	98	..
Firestone Tire & Rubber Co. pfd.	96	98	..
*General Motors Co. com.	97	98	+5
*General Motors Co. pfd.	77	78	+3
*B. F. Goodrich Co. com.	35	37	+1
*B. F. Goodrich Co. pfd.	94	99	+5¾
Goodyear Tire & Rubber Co. com.	135	140	..
Goodyear Tire & Rubber Co. pfd.	92	94	—2
Grant Motor Car Corp.	1½	2	—1
Hupp Motor Car Corp. com.	1½	2	—1½
Hupp Motor Car Corp. pfd.	72	78	..
International Motor Co. com.	12¾	13½	+1½
International Motor Co. 1st pfd.	23	25	—25
International Motor Co. 2nd pfd.	15	25	..
*Kelly-Springfield Tire Co. com.	40	41	+2
*Kelly-Springfield Tire Co. 1st pfd.	72	78	+2
*Lee Rubber & Tire Corp.	13½	14½	+2
*Maxwell Motor Co., Inc., com.	23½	24½	+2
*Maxwell Motor Co., Inc., 1st pfd.	54	55	+2
*Maxwell Motor Co., Inc., 2nd pfd.	20½	22	+2
Miller Rubber Co. com.	130	140	..
Miller Rubber Co. pfd.	95	98	..
Packard Motor Car Co. com.	95	103	+2
Packard Motor Car Co. pfd.	92	96	..
Paige-Detroit Motor Car Co.	11	12½	..
Peerless Truck & Motor Corp.	11	14	+1
Portage Rubber Co. com.	109	111	..
Regal Motor Car Co. pfd.	..	20	..
Reo Motor Car Co.	14	16	..
*Saxon Motor Car Corp.	6½	7½	+1
Springfield Body Corp. com.	..	..	..
Springfield Body Corp. pfd.	..	..	..
Standard Motor Construction Co.	7½	8½	..
Standard Parts Co.	..	78	+3
*Stewart-Warner Speed. Corp.	43	45	—1
*Studebaker Corp. com.	45	46	+ ½
*Studebaker Corp. pfd.	88	91	+10
Swinehart Tire & Rubber Co.	16	26	..
United Motors Corp.	18⅞	19	+2¼
*U. S. Rubber Co. com.	51	52	+1
*U. S. Rubber Co. pfd.	93	94	+1
*White Motor Co.	35	37	+1
*Willys-Overland Co. com.	19	19½	+ ½
*Willys-Overland Co. pfd.	72	75	+5

*At close December 29, 1917. Listed New York Stock Exchange.

OFFICIAL QUOTATIONS OF THE DETROIT STOCK EXCHANGE

ACTIVE STOCKS

	Bid	Asked	Net Ch'ge
Auto Body Co.	..	8¾	..
Bower Roller Bearing Co.	..	..	..
Chevrolet Motor Co.	92	94	+17
Commerce Motor Car Co.	..	..	..
Continental Motor Co. com.	5	5¼	..
Continental Motor Co. pfd. (new)	..	..	..
Edmunds & Jones com.	..	..	..
Edmunds & Jones pfd.	..	..	..
Ford Motor Co. of Canada	150	..	+5
Hall Lamp Co.	..	..	..
Michigan Stamping Co. com.	12	..	— ¼
Motor Products	..	..	..
Packard Motor Car Co. com.	90	96½	..
Packard Motor Car Co. pfd.	..	92¼	..
Paige-Detroit Motor Car Co.	12⅛	12¾	+ ⅞
Prudden Wheel Co.	10¾	..	+ ¼
Reo Motor Car Co.	15⅜	15⅝	— [illegible]

INACTIVE STOCKS

	Bid	Asked	Net Ch'ge
Atlas Drop Forge	..	32	..
Kelsey Wheel Co. pfd.	70	78	—10
Regal Motor Car Co. pfd.	..	26½	..

New Companies Formed

Latest additions to ranks of Automotive Industries

St. Louis Aircraft Co. To Make 3 Airplanes Daily

ST. LOUIS, Dec. 31—The St. Louis Air Craft Co. has been organized here, and in a few weeks will begin the manufacture of three airplanes daily. The motors will be shipped here to be placed in the assembled machines.

The Air Craft Co. was organized under the direction of A. J. Seigel, president of the Huttig Sash & Door Co., a planing mill. The St. Louis Car Co. joined in the organization to manufacture metal parts and the airplanes will be assembled at its plant. A small amount of special shop construction is required by the Huttig Co., but for the most part wooden parts will be manufactured in existing planing mills.

Zelle Tractor Co. Organized

ST. LOUIS, Dec. 31—The Zelle Tractor Co. has been organized to manufacture a tractor designed by William C. Zelle, a local engineer. The tractor has a 33-in. clearance, which enables its use as a cultivator of growing crops. Zelle is president of the new company and several local insurance men and bankers are officers. The company offers to sell $1,000,000 of stock in $20 shares.

Wisconsin Co. to Sell Supplies

APPLETON, WIS., Dec. 29—The Bradford Co. has been organized to deal in motor cars, accessories and supplies, with a capital stock of $25,000. The incorporators are H. N. Bradford, Benjamin Wild and E. Wild Bradford.

Smith Form-A-Truck Co. Formed in Milwaukee

MILWAUKEE, Dec. 29—The Smith Form-A-Truck Co. has been incorporated with a capital of $10,000 by William F. Coerper, Walter Mayer and Ray E. Coerper.

To Rebuild Storage Batteries

CLEVELAND, Dec. 28—The Storage Battery Rebuilding Co. has been incorporated for $13,000 by Henry L. Beggs and Samuel L. Bowlus.

London Wholesaler Opens Here

NEW YORK, Jan. 2—S. Smith & Sons Motor Accessories, Ltd., London, has opened a buying office in New York at 154 Nassau Street, with J. H. Rose in charge. Smith & Sons, which was established in 1841, and has branches in South Africa, Australia, New Zealand, the Dutch East Indies and Siam, has been finding it difficult to secure goods in England because of the war. Its volume in 1917 was nearly $4,000,000. The office will be permanently retained here after the war.

New Company to Make Safety Device

PEORIA, ILL., Dec. 29—The Safety Signal Corp. has been incorporated with a capital stock of $200,000 by B. F. Hardesty, W. H. Kirk and H. O. Johnson. The company will manufacture a safety device for motor cars.

Canadian Carburetor Co. Organized

TORONTO, Dec. 20—The (British) Young High-Velocity Carburetor Co., Ltd., has been incorporated with a capital of $250,000 by Henry H. Davis, Edward H. Brower, Lawrence A. Landriau and others. The company will manufacture carbureters, automobile accessories and machinery.

To Manufacture Bovey Heaters

CHICAGO, Jan. 2—The Bovey Automobile Heater Co. has been incorporated with a capital of $30,000 by Thomas Bovey, Sidney J. Bovey and Frank Thomason.

Engineering Corp. to Solve Truck Problems

CHICAGO, Dec. 26—The Engineering & Sales Corp., 122 South Michigan Avenue, Chicago, has taken over the engineering problems and supervision of purchases of the Oklahoma Auto Mfg. Co., Muskogee, Okla., and of the Mutual Truck Co., Sullivan, Ind.

Dividends Declared

BUFFALO, Jan. 2—The Curtiss Aeroplane & Motors Corp. has declared a semi-annual dividend of 3½ per cent on preferred stock, payable Jan. 15, to stock of record Jan. 2.

CLEVELAND, Dec. 27—The National Tool Co. has declared the regular quarterly and the usual extra dividend on common stock, together with 3 per cent interest and the regular quarterly dividend on preferred, all payable Jan. 2 to stock of record Dec. 28.

SPRINGFIELD, OHIO, Dec. 29—The Westcott Motor Car Co. has declared the regular quarterly dividend on the 7 per cent preferred stock, payable to stock of record Dec. 31.

PITTSBURGH, Jan. 2—The Westinghouse Electric & Mfg. Co. has declared a regular quarterly dividend of 1¾ per cent on common, payable Jan. 31 to stock of record Dec. 31, and a dividend of 20 per cent in stock payable Jan. 15 to stock of record Dec. 31.

Current News of Factories

Notes of New Plants—Old Ones Enlarged

United States Motor Truck Plans to Triple Output

COVINGTON, OHIO, Dec. 28—Officers and department heads of the United States Motor Truck Co., Cincinnati, gave a dinner at the Industrial Club in honor of F. J. Alvin, general manager of the company. The officers pledged their determination to triple the output during the next year.

Those present included: R. C. Stewart, president of the company; R. S. Stewart, vice-president; F. J. Alvin, E. S. Lee, Jr.; E. C. Shumard, W. E. Dugan, E. A. Haskins, F. A. Trinkle, C. E. Hoover, William Lally, Fred Geiger, A. C. Durant, A. O. Fenning, H. W. Gillespie, E. B. Chamberlain, O. W. Williams, H. Z. Yeager, T. W. Semler, Walter Walkinghorst and Ralph H. Jones.

Haskelite May Use United Truck Building

GRAND RAPIDS, Jan. 2—The Haskelite Co., which manufactures veneer parts for airplanes, is starting work on its new plant. Pending its completion one of the new buildings of the United Motor Truck Co. will probably be used for experimental work in the making of airplane bodies.

Studebaker to Build New Factory

DETROIT, Dec. 27—The Studebaker Corp. has secured a building permit for a 4-story brick and steel factory 325 x 51. The cost will be approximately $150,000.

Indiana Truck Co. Plans Expansion

MARION, IND., Dec. 31—The Indiana Truck Co. will enlarge its plant to provide for a Government contract for 500 Liberty trucks.

American Forge to Build Heat Treating Plant

CANTON, O., Jan. 2—The American Forge & Machine Co., Canton, Ohio, is erecting a steel building 40 x 100 as a heat treating department. The building will be equipped with car type furnaces, heat receiving instruments and quenching tanks, thus insuring the scientific treatment of all forgings. Testing machines of various types will be installed.

One-Wheel Trucks in Market Jan. 3

ST. LOUIS, Dec. 31—The One-Wheel Truck Co. announces that first deliveries will begin Jan. 10. On that date three of the novel motors will come out of the shop. The first will go to the Anheuser-Busch Brewing Association.

Industrial Review of the Week

A Summary of Major Developments in Other Fields

COAL SITUATION IMPROVING

The consumption of anthracite has somewhat decreased during the past week. This has been due almost entirely to moderation of weather conditions, resulting in a less insistent demand for domestic fuel. The railroads have also by a strenuous cleaning up of the congested conditions resulting from the great snow storm of early December been able to move a slightly greater tonnage than during the past two or three weeks. The efforts of the anthracite operators to induce the mine workers to produce a maximum tonnage have been reinforced by admonitions from various ecclesiastics high in the Roman church, urging the miners to labor to their maximum capacity even on Sunday and other church days, excepting only Christmas and New Year's Day. It is rumored also that the period of labor during the present war may be extended from eight to nine hours per day. All of these circumstances combine to render the situation less strenuous than it has been in the recent past. On the other hand, car supplies to the mines and movement all-rail, particularly to New England points, have been poor, and some suffering has resulted from a lack of adequate fuel supply. It is hoped that the use of government locomotives, as well as those diverted to the East from points further west, will tend still more strongly to relieve the present situation.

The situation in bituminous coal is apparently but little less strenuous than formerly, the chief factor tending to relieve the situation being milder weather than formerly prevailed. On the other hand, there are certain symptoms which would indicate that the scarcity of domestic fuel particularly was not as great as was believed. Among these indications are the unwillingness of certain consumers who complained loudly that they were "freezing" to pay the contract price for coal which had been commandeered to meet their needs. The distribution of a considerable tonnage of coal intended for Lake shipment did much to relieve immediate fuel needs in Ohio and lower Lake territory generally. On the other hand, such manufacturing districts as Michigan and New England are extremely short of coal supplies, and unless a considerable tonnage is received shortly many manufacturing plants and public utilities will doubtless be required to close down, at least temporarily. A strong sentiment prevails which would favor the compulsory shutting down of unessential industries, such as the manufacture of musical instruments, and the like. This would not only relieve a certain amount of traffic in raw materials and finished product, but would tend also to set free a certain amount of labor which might be more advantageously used in other pursuits. Proper priority orders will doubtless accomplish this result. Already many cities have adopted "lightless nights," this term being applied to the burning of electric signs and similar advertising illumination. In some places also apartment house owners have adopted stringent measures to reduce the consumption of coal for heating purposes, while curtailment of street and interurban electric lines and abandoning of many passenger trains on various roads which were more or less superfluous, have all done much to conserve slender stocks of fuel. Complaints of shortage in bituminous coal are most pronounced among steam users, while the domestic consumers appear to be, if anything, better taken care of. It is apparent thus that although the production and receipt of steam coal is at least equal to that of last year, and in many cases far greater, the manufactories of the country are running at much higher capacity than was the case a year ago. —*Coal Age.*

A New Service

Herewith AUTOMOTIVE INDUSTRIES *supplies for the benefit of its readers a general summary of important developments in other fields of business. This is rendered possible by the editorial co-operation of leading industrial publications which are recognized authorities.*

By compressing the general industrial situation into this form we hope to give our readers a clear and comprehensive idea of up-to-the-minute developments which they could otherwise secure only with considerable expenditure of time and effort.

CLEVELAND ORE PRODUCERS OBJECT TO CONTRACT REVISIONS

The expected announcement by the President that iron and steel prices would remain in effect for three months longer was made on Dec. 28. With it came the proviso, agreed to at a meeting of steel manufacturers and the War Industries Board held the same day, that on contracts made in the next three months prices would be revised on deliveries after April 1 to conform to any changes that might become effective on that date.

Iron ore producers at Cleveland are emphatic in objecting to the action taken as to the revision of contracts. Representing an industry in which contracts have always been made running 12 months ahead, they are opposed to making ore sales subject to a possible reduction in price. Pig iron soared far out of range with the ore prices of 1917, and the ore trade argues that for it an advance is in order now rather than a possible reduction.

The prospect of orders for 100,000 cars that comes with Government control of railroads is not unwelcome to equipment companies, but with the steel trade the practical question is what tonnage of plates can be spared for car building. The shipbuilding program will absorb more steel later in the year, but new plate capacity is nearing completion and shipyards are not yet organized to take the present plate mill output in full.

Surprisingly large additions to the country's steel making capacity are shown by the statistics for 1917. In the year 97 new open-hearth furnaces, some of which will be operated duplexing, were completed, capable of an output of 4,326,500 tons of ingots per year. Of this total 1,220,000 tons is furnished by the Steel Corporation. In 1916, previously the record year, the new capacity added was 4,205,000 tons.

Fourteen new blast furnaces were blown in in 1917, with annual capacity of 2,520,000 tons, against only five furnaces in 1916 with capacity of 800,000 tons.

In the face of all this new construction is the fact that pig iron production in 1917, estimating that of December at 3,000,000 tons, was but 38,700,000 tons, or 735,000 tons less than in 1916. Coke was the limiting factor, as has been said over and over.

At the same time, by drawing on pig iron stocks and by a larger use of scrap, steel works produced about 42,400,000 tons of ingots last year, or 1,000,000 tons more than in 1916, making 1917 the high record year.

The 9000 railroad cars for Italy are about placed. The bulk if not all is likely to go to the Standard Steel Car Co. and the American Car & Foundry Co. Both have uncompleted Russian car orders and could utilize some of the steel on hand and under orders.

Manufacturing consumers end the year as a rule with fair stocks of material. In many general lines activity has tapered off, and with Government price control there has not been the incentive to seek maximum protection through contracts. Now that Washington stipulates that price revision on deliveries after March 31 will be in order, the average buyer may show more interest. Meanwhile his output has been subnormal because of transportation delays and labor shortage, and this fact accounts for the smaller stocks he has been satisfied to carry.

In northern Ohio, in contrast with some other districts, there is active demand for pig iron, one inquiry from Erie, Pa., representing Government work, being for 3000 tons of basic iron per month for a year, beginning with March.—*Iron Age.*

Open Bids for Postal Trucks

WASHINGTON, Jan. 2—The post-office department will open bids Jan. 10, at 2 o'clock p. m., for not to exceed fifty motor gasoline motor trucks of from 1 to 1½-ton capacity, equipped as follows:

Screen body, screens front and rear; front screens, collapsible gate type; rear screens, hinged doors opening outward, with proper lock; body built out over wheels with wells in front to accommodate wheels; screens to be carried up from edge of flare boards to roof, properly supported; tires, 36 by 6, pneumatic cord, extra tire mounted on rim; tire rack, complete; headlight lenses to be of a type meeting requirements of various State laws; each car equipped with full set of chains and the customary tool equipment; bodies to be painted green, with gold lettering and red running gear.

Torbensen Axle Co. Insures Employees

CLEVELAND, Dec. 28—The Torbensen Axle Co. gave each of its 500 employees a certificate of insurance as a Christmas gift. Those who have entered the service of the company since July 1, 1917, are insured for $250, this amount to be raised to $500 upon completion of 6 months' service. Those who have been with the company for more than a year are insured for $600, with an increase of $100 for each additional year of service until a maximum of $1,500 has been provided. This insurance was in force from noon of Dec. 24, and does not interfere with the Workman's Compensation as provided by the Ohio State law.

Model Factory for Fan Belts

ENDICOTT, PA., Dec. 31—Walter L. Johnson, manufacturer of fan belts, will open a model factory here. The building will be 150 x 60, and more than 3,000,000 fan belts will be manufactured in it during 1918.

Calendar

ASSOCIATIONS

Jan. 3-4—New York Automotive Electric Assn. meeting.
Jan. 7-8—New York, National Automobile Dealers' Assn. directors' meeting with vice-presidents from Eastern States.
Feb. 4-7—St. Louis, American Road Builders' Assn. Convention.

SHOWS

January — Kalamazoo, Mich., Kalamazoo Automobile Dealers' Assn., Armory.
Jan. 2-9—New York, Salon, Automobile Salon, Inc., Astor Ballroom. John R. Eustis, Mgr.
Jan. 5-12 — New York Show, Grand Central Palace, National Automobile Chamber of Commerce.
Jan. 11-19 — Philadelphia, 17th Annual Show, Philadelphia Auto Trade Assn., Commercial Museum Bldg.
Jan. 11-19—Providence, R. I., R. I. Licensed Auto. Dealers' Assn., State Armory. Percival S. Clark, Mgr.
Jan. 14-19 — Rochester, N. Y., Tenth Annual Exposition Park. C. A. Simmons, Mgr.
Jan. 16-27 — Milwaukee, Wis., Milwaukee Automobile Dealers, Inc., Auditorium. (First 7 days, passenger cars; last 3 days, commercial cars.) Bart J. Huddle, Mgr.
Jan. 18-24 — Des Moines, Ia., Ninth Annual Passenger Car and Second Annual Truck, Des Moines Automobile Dealers' Assn., Coliseum. C. G. Van Vliet and Dean Schooler, Mgrs.
Jan. 19-26—Detroit Automobile Dealers' Assn., Overland Bldg. H. H. Shuart, Mgr.
Jan. 19-26 — New York Motor Boat Show, Grand Central Palace, National Assn. of Engine and Boat Manufacturers.
Jan. 19-26—Detroit, Willis Avenue Overland Service Station.
Jan. 19-27 — Cleveland, Seventeenth Annual. Cleveland Automobile Show Co., Wigmore Coliseum. Fred. H. Caley, Mgr.
Jan. 19-28 — Montreal, Can., Montreal Automobile Trade Assn., Ltd., Almy Bldg. T. C. Kirby, Mgr.
Jan. 21-26—Manchester, N. H., Academy. Couture Bros.
Jan. 21-26—Scranton, Pa., Scranton Motor Trades Assn., Armory. Hugh B. Andrews, Mgr.
Jan. 21-26—York, Pa., Queen Street Tabernacle, York Automobile Dealers' Assn.
Jan. 21-26 — Wilmington, Del., Hotel Du Pont.
Jan. 21-26—Buffalo, N. Y., Buffalo Automobile Dealers' Assn., Broadway Auditorium.
Jan. 21-26 — Richmond, Va., Richmond Automobile Dealers' Association, First Regimental Armory. Henry B. Marks, Mgr.
Jan. 22-24—Montreal, Can., Convention of All Men Interested in the Automobile Industry in Eastern Canada.
Jan. 22-25—Oklahoma City, Oklahoma City Motor Car Dealers Assn. Carhart Building.
Jan. 22-26—Baltimore, Md., Baltimore Automobile Dealers' Assn. and Automobile Club of Maryland, 5th Regiment Armory.
Jan. 22-26 — Oklahoma City, Okla., Oklahoma City Automobile Dealers' Assn., 701 No. Broadway. Roy H. Haun, Mgr.
Jan. 23-28—Allentown, Pa., Lehigh Auto. Trade Assn., Traylor Motor Co.'s Garage. P. W. Leisering, Publicity Mgr.
Jan. 26-Feb. 2 — Chicago National Show, Coliseum and Armory, National Automobile Chamber of Commerce.
Jan. 26-Feb. 2—Chicago, Salon, Elizabeth Room of Congress Hotel.
Jan. 26-Feb. 2—Bridgeton, N. J., Bridgeton Auto Dealers' Assn. O. P. Riley, Sec.
Jan. 26-Feb. 2—Harrisburg, Pa., Capital City Motor Dealers' Assn. J. Clyde Myton, Mgr.
Jan. 26-Feb. 3—York, Pa., York County Auto. Dealers' Assn., Tabernacle. T. F. Pfeiffer, Sec.
Jan. 28-Feb. 2—Buffalo, N. Y., Buffalo Automobile Dealers' Assn., Broadway Auditorium.
February — Greensburg, Pa., Westmoreland Automobile Dealers' Association.
Feb. 2-16—Bronx, N. Y., Bronx Auto. Dealers' Assn., Second Battery Armory. D. J. Barrett, Chairman Show Committee.
Feb. 5-9—Binghamton, N. Y., Binghamton Automobile Dealers' Assn., Kalurah Temple. William M. McNulty, Mgr.
February — Peoria, Ill., Peoria Auto and Accessories Dealers' Assn. W. O. Ireland, Mgr.
Feb. 6-9—Lancaster, Pa., Automobile Track Assn., Fidelity Bldg. R. W. Shreiner, Mgr.
Feb. 9-16 — Bronx, N. Y., 2d Battery Armory, Bronx Automobile Dealers' Assn. D. J. Barrett, Mgr.
Feb. 11—Toledo, Terminal Auditorium, Toledo Auto Show Co.
Feb. 11-16—St. Louis, Mo., St. Louis Auto Mfrs. & Dealers' Assn. Robert E. Lee, Mgr.
Feb. 11-16 — Kansas City, Mo., Kansas City Motor Car Dealers' Assn., Convention Hall. E. E. Peake, Mgr.
Feb. 11-16—Kansas City, Mo., Third Annual National Tractor Show.
Feb. 11-16—Toledo, O., Toledo Auto Shows Co.
Feb. 16-23—New York, Second Pan-American Aeronautic Exposition, Grand Central Palace and Madison Square Garden.
Feb. 16-24—San Francisco, Cal., San Francisco Dealers' Assn., Exposition Auditorium. G. A. Wahlgreen, Mgr.
Feb. 18-23—Grand Rapids, Mich., Automobile Business Assn., Klingman Building. Ernest T. Conlon, Mgr.
Feb. 18-23—Newark, N. J., N. J. Auto Exhibition, Co. G, First Regiment Armory. Claude E. Holgate, Mgr.
Feb. 18-23—Des Moines, Ia., Des Moines Automobile Dealers' Assn., Coliseum. C. G. Van Vliet & Dean Schooler, Mgrs.
Feb. 16-23—Newark, N. J., First Regiment Armory.
Feb. 18-23 — Springfield, Ohio, Springfield Auto Trades Assn., Memorial Hall. C. S. Burke, Mgr.
Feb. 18-23 — Waterbury, Conn., United Shows Co.
Feb. 18-23—Duluth, Minn., Duluth Automobile Trade Association. John J. Lane, Mgr.
Feb. 18-24 — Des Moines, Ia., Ninth Annual Passenger and Second Annual Truck, Des Moines Automobile Dealers' Assn., Coliseum. C. G. Van Vliet & Dean Schooler, Mgrs.
Feb. 18-24—Des Moines, Ia., Second Annual Truck, Auditorium. Dean Schooler & C. G. Van Vliet, Mgrs.
Feb. 18-25 — Pittsfield, Mass., State Guard, State Armory. James J. Callaghan, Mgr.
Feb. 20-23—Quincy, Ill., First Annual, Armory. L. B. Bartlett, Mgr.
Feb. 18-27—So. Bethlehem, Pa., Fourth Annual (cars 18-23; trucks 25-27), Coliseum. J. L. Elliott, Mgr.
Feb. 22-Mar. 9—Brooklyn, N. Y., Brooklyn Motor Vehicle Dealers' Assn., Twenty-third Regiment Armory. I. C. Kirkham, Treas.
Feb. 25-Mar. 2—Muskegon, Mich., Second Annual, Merrill Auditorium. John C. Fowler, Mgr.
Feb. 25 - Mar. 2 — Bridgeport, Conn., Fourth Regiment Conn. Home Guard, State Armory & Casino. B. B. Steiber, Mgr.
Feb. 27-Mar. 2—Columbus, O., Auto Exhibitors Co. W. L. Carney, Mgr.
Feb. 27-Mar. 6—Boston, Mass., Salon, Boston Automobile Dealers' Assn., Copley Plaza Hotel. Chester I. Campbell, Mgr.
Mar. 1 — Lyons, France, Third Sample Fair.
Mar. 2-9—Pittsburgh, Pa., Automobile Dealers' Assn. of Pittsburgh, Motor Square Garden. John J. Bell, Mgr.
Mar. 4-9—Utica, N. Y., Utica Motor Dealers' Association, Inc., State Armory.
Mar. 6-9—Clinton, Ia., Clinton Automobile Dealers' Assn., Coliseum.
Mar. 8-11 — Green Bay, Wis., Brown County Automobile Trade Assn.
Mar. 15-20—Great Falls, Mont., Montana Automobile Distributers' Association, Lexington Garage. A. J. Breitenstein, Mgr.
Mar. 16-20—Great Falls, Mont., Montana Automobile Distributers' Assn.
Mar. 19-24—Cedar Rapids, Ia., Cedar Rapids Auto Trade Assn., Auditorium.
Mar. 20-22—Houlton, Me., Second Annual, Houlton Motor Car Dealers' Assn., Bangor St. Exhibition Hall. J. D. Luth, Mgr.
Apr. 9-13—Stockton, Cal., San Joaquin Auto Trade Assn. Samuel S. Cohn, Mgr.
Sept. 23-28 — Chicago, National Accessory Show for Fords, Coliseum.

S. A. E.

Jan. 9—New York, Tenth Annual Dinner, Motor & Accessory Mnfrs. Assn., Waldorf-Astoria, 7:30 p. m.
Jan. 10—New York, Automotive Dinner at Hotel Biltmore.
Jan. 11-16—New York, Convention, National Association Automobile Accessory Jobbers, Hotel Astor.
Jan. 29-31—Chicago, Annual Convention, Garage Owners' Assn. of Ill., Green Room, Congress Hotel.
Feb. 1 — Chicago, War Dinner during Winter Meeting.

Engineering

American Society of Heating and Ventilating Engineers.
Mining and Metallurgical Society of America.

1918 Passenger Automobiles Listed

MAKE AND MODEL	Wheelbase	No. of Cylinders	Bore and Stroke, Inches	Piston Displacement, Cubic Inches	Make of Engine	Cylinder Shape	Camshaft Drive	Water Circulation	LUBRICATION System	LUBRICATION Type of Pump	CARBURETION Make of Carbureter	CARBURETION Fuel Feed	IGNITION System	IGNITION Make	IGNITION Control	ELECTRIC SYS Generator Make	ELECTRIC SYS Voltage	CLUTCH Make	CLUTCH Type
Abbott.......6-62	122	6	3½x5¼	303	Continent.	L..	Helical..	Cent..	Splash-Pres..	Piston..	Stromberg..	Vacuum..	Single..	Remy.......	Hand.	Remy.......	6	Muncie....	Disk...
Allen.......41	112	4	3¾x5	221	Own......	L..	Helical..	Ther..	Circ-Spl.....	Piston..	Stromberg..	Vacuum..	Single..	Connecticut..	Hand.	Auto-Lite....	6	Borg & Beck	Plate..
American.......B	122	6	3⅛x5	230	Rutenber..	L..	Helical..	Cent..	Splash-Pres..	Piston..	Zenith.....	Vacuum..	Single..	G&D.......	Hand.	G&D.......	6	Borg & Beck	Plate..
Anderson.......20	120	6	3¼x4½	224	Continent.	L..	Helical..	Cent..	Splash-Pres..	Piston..	Zenith.....	Vacuum..	Single..	Connecticut..	Hand.	Westinghouse	6	Borg & Beck	Plate..
Apperson.......	130	6	3½x5	288	Own......	L..	Helical..	Cent..	Splash-Pres..	Gear...	Rayfield....	Vacuum..	Single..	Remy.......	Hand.	Bijur.......	6	Own.......	Plate..
Apperson.......	130	8	3¼x5	332	Own......	L..	Helical..	Ther..	Splash-Pres..	Gear...	Johnson....	Vacuum..	Single..	Remy.......	Hand.	Bijur.......	6	Own.......	Plate..
Arbens.......25	108	4	3¼x5	166	Lycoming..	L..	Helical..	Ther..	Splash......	Piston..	Carter.....	Gravity..	Single..	Dyneto.....	Hand.	Dyneto......	6	....	Cone..
Auburn.......6-39	120	6	3¼x4½	224	Teet-Hart.	L..	Helical..	Cent..	Splash-Pres..	Piston..	Rayfield....	Vacuum..	Single..	Remy.......	Hand.	Remy.......	6	Borg & Beck	Plate..
Auburn.......6-44	131	6	3½x5¼	303	Continent.	L..	Helical..	Cent..	Splash-Pres..	Piston..	Rayfield....	Vacuum..	Single..	Remy.......	Hand.	Remy.......	6	Borg & Beck	Plate..
Austin.......	142	12	2⅞x5	389	Weidely...	I..	Helical..	Cent..	Pressure.....	Gear...	Stromberg..	Vacuum..	Single..	Delco.......	Hand.	Delco.......	6	Muncie.....	Disk...
Biddle.......H	121	4	3¾x5⅛	226	Buda.....	L..	Helical.	Ther..	Circ-Spl.....	Gear...	Zenith.....	Vacuum..	Single..	Eisemann....	Hand.	G&D.......	6	Own.......	Plate..
Bour-Davis.......18A	118	4	3¾x5	220	Continent.	I..	Helical..	Cent..	Circ-Spl.....	Gear...	Miller......	Vacuum..	Single..	Westinghouse	Hand.	Westinghouse	6	Borg & Beck	Plate..
Bour-Davis.......18B	118	6	3½x5¼	303	Continent.	L..	Helical..	Cent..	Circ-Spl.....	Piston..	Stromberg..	Vacuum..	Single..	Westinghouse	Hand.	Westinghouse	6	Borg & Beck	Plate..
Brewster.......1	125	4	4 x5½	276	Own......	K.	Chain...	Cent..	Pressure.....	Gear...	Zenith.....	Vacuum..	Single..	Bosch.......	Hand.	U-S-L......	12	Own.......	Cone..
Briscoe.......4-24	104	4	3 3/16x5⅛	163	Own......	L..	Helical..	Ther..	Circ-Spl.....	Piston..	Dave-Buick.	Gravity..	Single..	Connecticut..	Hand.	Auto-Lite....	6	Own.......	Rev-C..
Buick.......E-4-34	106	4	3⅜x4¾	170	Own......	I..	Helical	Cent.	Circ-Spl.....	Gear...	Marvel.....	Vacuum..	Single..	Delco.......	H&A..	Delco.......	6	Own.......	Cone..
Buick.......E-4-35	106	4	3⅜x4¾	170	Own......	I..	Helical..	Cent..	Circ-Spl.....	Gear...	Marvel.....	Vacuum..	Single..	Delco.......	H&A..	Delco.......	6	Own.......	Cone..
Buick.......E-6-44	118	6	3⅜x4½	242	Own......	I..	Helical..	Cent..	Circ-Spl.....	Gear...	Marvel.....	Vacuum..	Single..	Delco.......	H&A..	Delco.......	6	Own.......	Disk...
Buick.......E-6-45 & 46	118	6	3⅜x4½	242	Own......	I..	Helical..	Cent..	Circ-Spl.....	Gear...	Marvel.....	Vacuum..	Single..	Delco.......	H&A..	Delco.......	6	Own.......	Disk...
Buick.......E-6-49 & 50	124	6	3⅜x4½	242	Own......	I..	Helical..	Cent..	Circ-Spl.....	Gear...	Marvel.....	Vacuum..	Single..	Delco.......	H&A..	Delco.......	6	Own.......	Disk...
Cadillac.......57	{125 / 132	8	3⅛x5⅛	314	Own......	L..	Chain...	Cent..	Pressure.....	Gear...	Own.......	Pressure..	Single..	Delco.......	H&A..	Delco.......	6	Own.......	Disk...
Campbell.......	110	4	3⅞x4	189	Own......	L..	Sp-G....	Ther..	Circ-Spl.....	Gear...	American..	Vacuum..	Single..	At Kent.....	Hand	Auto-Lite....	6	Muncie.....	Disk...
Case.......U	125	6	3½x5¼	303	Continent.	L..	Helical..	Cent..	Splash-Pres..	Piston..	Rayfield....	Vacuum..	Single..	Westinghouse	Hand	Westinghouse	6	Borg & Beck	Plate...
Chalmers.......	{117 / 122	6	3¼x4½	224	Own......	L..	Chain...	Ther..	Splash-Pres..	Gear...	Stromberg..	Vacuum..	Single..	Remy.......	Hand	Westinghouse	6	Own.......	Disk...
Chandler.......25	123	6	3½x5	289	Own......	L..	Chain...	Cent..	Splash-Pres..	Piston..	Rayfield....	Vacuum..	Single..	Bosch.......	Hand	Westinghouse	6	Borg & Beck	Plate...
Chevrolet.......490	102	4	3 11/16x4	171	Own......	I..	Helical	Cent..	Splash-Pres..	Gear...	Zenith.....	Gravity..	Single..	Remy.......	Hand	Auto-Lite....	6	Own.......	Cone..
Chevrolet.......	108	4	3 11/16x5¼	224	Own......	I..	Helical..	Cent..	Splash-Pres..	Gear...	Zenith.....	Vacuum..	Single..	Remy.......	Hand	Auto-Lite....	6	Own.......	Cone..
Chevrolet.......D-4 & D-5	120	8	3⅜x4	286	Own......	I..	Helical..	Cent..	Splash-Pres..	Gear...	Zenith.....	Vacuum..	Single..	Remy.......	Hand	Auto-Lite....	6	Own......	Cone..
Cole.......870	127	8	3½x4½	346	Northway.	L..	Helical..	Gear..	Pressure.....	Gear...	Stromberg..	Vacuum..	Single..	Delco.......	H&A..	Delco.......	6	Northway..	Cone..
Columbia.......C&D	115	6	3¼x4½	224	Continent.	L..	Helical.	Cent..	Splash-Pres..	Piston..	Stromberg..	Vacuum..	Single..	At Kent.....	Hand.	Rob-Myers..	9	Borg & Beck	Plate...
Comet.......C-50	125	6	3½x5	289	Lewis.....	L..	Helical..	Cent..	Splash-Pres..	Piston..	Miller......	Vacuum..	Single..	Delco.......	H&A..	Dyneto.....	6	Mechanics..	Disk...
Commonwealth.......4-40	112	4	3½x5	192	Lycoming..	L..	Helical..	Ther..	Circ-Spl.....	Piston..	Carter.....	Vacuum..	Single..	At Kent.....	Hand	Dyneto.....	6	Mechanics..	Disk...
Crawford.......6-40	122½	6	3½x5¼	303	Continent.	L..	Helical..	Cent..	Circ-Spl.....	Piston..	Stromberg.	Vacuum..	Double.	Bosch.......	Hand	Westinghouse	6	Own.......	Plate..
Crow-Elkhart.......CE-36	114	4	3½x5	192	Own......	I..	Helical.	Ther..	Circ-Spl.....	Gear...	Zenith.....	Vacuum..	Single..	Connecticut..	Hand	Dyneto.....	6	Borg & Beck	Plate..
Cunningham.......	{132 / 142	8	3¾x5	442	Own......	L..	Helical..	Cent..	Pressure.....	Gear..	Stromberg..	Vacuum..	Single..	Delco.......	H&A..	Westinghouse	6	....	Disk...
Daniels.......B	127	8	3¼x5	332	Hersh-Sp..	L..	Helical..	Cent..	Pressure.....	Gear...	Zenith.....	Vacuum..	Single..	Westinghouse	Hand	Westinghouse	6	Brown-Lipe.	Disk...
Davis.......H, I & K	119	6	3¼x4½	224	Continent.	L..	Helical..	Cent..	Splash-Pres..	Piston..	Stromberg..	Vacuum..	Single..	Delco.......	Hand	Delco.......	6	T.W Warner	Cone..
Davis.......J & JI	125	6	3½x5¼	303	Continent.	L..	Helical..	Cent..	Splash-Pres..	Piston..	Stromberg..	Vacuum..	Single..	Delco.......	H&A.	Delco......	6	T.W.Warner	Cone..
Dishbrow.......A	116	4	5 1/16x5½	446	Wisconsin.	T..	Sp-G....	Cent..	Pressure.....	Gear...	Miller......	Pressure..	Single..	K-W.......	Hand	Leece-N.....	12	Warner...	Disk...
Dispatch.......G	120	4	3¾x5	221	Wisconsin.	L..	Helical..	Ther..	Pressure.....	Gear...	Rayfield....	Vacuum..	Single..	Delco.......	Hand	U-S-L......	12	Own.......	....
Dodge.......	114	4	3⅞x4½	212	Own......	L..	Helical..	Cent..	Circ-Spl.....	Gear...	Stewart....	Vacuum..	Single..	Delco.......	H&A..	North-East..	12	Own.......	Disk...
Dorris.......I-C	130	6	4 x5	377	Own......	I..	Helical..	Cent..	Pressure.....	Gear...	Stromberg..	Vacuum..	Single..	Bosch.......	Hand.	Westinghouse	6	Brown-Lipe.	Disk...
Dort.......11	105½	4	3½x5	192	Lycoming..	L..	Helical..	Ther..	Circ-Spl.....	Piston..	Carter....	Gravity..	Single..	Connecticut..	Hand.	Westinghouse	6	Own.......	Cone..
Elcar.......	116	4	3½x5	192	Lycoming..	L..	Helical..	Ther..	Circ-Spl.....	Piston..	Carter....	Vacuum..	Single..	At Kent.....	Hand.	Dyneto.....	6	Mechanics..	Disk...
Elcar.......	116	6	3¼x4½	224	Continent.	L..	Helical..	Cent..	Splash-Pres..	Piston..	Stromberg..	Vacuum..	Single..	At Kent.....	Hand	Dyneto.....	6	Borg & Beck	Plate..
Elgin.......A	117	6	3⅛x4¼	196	Falls......	I..	Helical..	Ther..	Circ-Spl.....	Piston..	Stromberg..	Vacuum.	Single..	Wagner.....	Hand.	Wagner.....	6	Borg & Beck	Plate..
Empire.......50-51	115	4	3⅞x5	236	Teet-Hart.	T..	Helical..	Cent..	Circ-Spl.....	Piston..	Stromberg..	Vacuum..	Single..	Connecticut.	Hand.	Auto-Lite...	6	Borg & Beck	Plate..
Empire.......70-A	120	6	3¼x4½	224	Continent.	L..	Helical..	Cent..	Splash-Pres..	Piston..	Stromberg..	Vacuum..	Single..	Connecticut..	Hand	Auto-Lite....	6	Borg & Beck	Plate..

ABBREVIATIONS

2-pt—*Two Point*
¾ Ell—¾ *Elliptic*
¾ *Float*—¾ *Floating*
¾ Plat—¾ *Platform*
Amid—*Amidships*
Atmtc—*Automatic*
B & P—*Ball and Plain*
B & R—*Ball and Roller*
B R & P—*Ball, Roller and Plain*
C & C—*Cup and Cone*
Cant—*Cantilever*
Cent—*Centrifugal*
Circ-Spl—*Circulating Splash*
Dual-D—*Dual Double*
Ell—*Elliptic*
F—*F-Head*
Float—*Floating*
Fric—*Friction*
Gear—*Gear Pump*
H—*Horizontal*
H & A—*Hand and Automatic*
I—*I-Head*
Imp—*Impeller*
K—*Knight type*
L—*L-Head*
Mag—*Magnetic*
Non-Spl—*Non-Circulating Splash*
Opt—*Optional*
Plan—*Planetary*
Plat—*Platform*
Rad-Rd—*Radius Rods*
Rev-C—*Reversed Cone*
Roll—*Roller*
S-A—*Semi-Automatic*
S-E—*Semi-Elliptic*
Semi-F—*Semi-Floating*
Sp-B—*Spiral Bevel*
Sp-G—*Spiral Gear*

with Their Technical Specifications

TRANSMISSION								RUNNING GEAR							BEARINGS			
GEARSET							Gear Ratio on Direct	TIRES						Crank-shaft Bearings and Number				
Make	Location	Forward Speeds	Final Drive	Torque Taken By	Make of Rear Axle	Rear Axle Type		Front	Rear	Wheels	Rear Spr'gs	Make of Steering Gear	Make of Speed-ometer		Gearset	Rear Axle	Front Wheel	MAKE AND MODEL
Muncie	Unit M	3	Sp.B	Springs	Salisbury	¾ Float	4.30-1	34x4	34x4	Wood†	S-E	Gemmer	Stewart	Plain 3	Ball	B&R	Roll	**Abbott** 6-62
Own	Unit M	3	Sp.B	Springs	Adams	Float	4.25-1	32x3½	32x3½	Wood	S-E	Ditwiler	Stewart	Plain 2	B&R	Ball	Roll	**Allen** 41
Mechanics	Unit M	3	Sp.B	Springs	Salisbury	¾ Float	4.42-1	32x4	32x4	Wood	S-E	Gemmer	Van Sicklen	Plain 3	B&P	B&R	Ball	**American** B
Durston	Unit M	3	Sp.B	Springs	Columbus	¾ Float	4.58-1	33x4	33x4	Wood†	S-E	C. A. S.	Stewart	Plain 3	Ball	Roll	Ball	**Anderson** 20
Own	Amid	3	Sp.B	Springs	Own	Semi-F	4.25-1	34x4	35x4½	Wood†	¾-Ell	Own	Van Sicklen	Plain 4	Roll	Roll	Plain	**Apperson**
Own	Amid	3	Sp.B	Springs	Own	Semi-F	4.25-1	34x4	35x4½	Wood†	¾-Ell	Own	Van Sicklen	Plain 3	Roll	Roll	Roll	**Apperson**
	Unit M	3	Bevel	Springs	Gemco	Float	4.25-1	30x3½	30x3½	Wood	Cant		Carter	Plain 2	Ball	Roll	Ball	**Arbenz** 25
Grant-Lees	Unit M	3	Sp.B	Tor-A		¾ Float	4.42-1	34x4	34x4	Wood	S-E	Jacox	Stewart	Plain 3	Ball	Roll	Ball	**Auburn** 6-39
Grant-Lees	Unit M	3	Sp.B	Tor-A		Float	4.08-1	35x4½	35x4½	Wood	Cant			Plain 3	Ball	Roll	Ball	**Auburn** 6-44
Muncie	Unit M	3	Sp.B	Springs	Own	Float	*3.75-1 *5.25-1	34x4½	34x4½	Wood†	Cant	Lavine	Stewart	Plain 3	Ball	B&R	Roll	**Austin**
Own	Unit M	4	Sp.B	Springs	Own	Float	4.40-1	32x4	32x4	Wire	S-E	Gemmer	Warner	Plain 3	B&R	Roll	Roll	**Biddle** H
Detroit	Unit M	3	Sp.B	Springs	Salisbury	¾ Float	4.00-1	32x4	32x4	Wood	S-E	Gemmer	Van Sicklen	Plain 3	Ball	Roll	Ball	**Bour-Davis** 18A
Detroit	Unit M	3	Sp.B	Springs	Salisbury	¾ Float	4.07-1	33x4½	33x4½	Wood	S-E	Gemmer	Van Sicklen	Plain 3	Ball	Roll	Ball	**Bour-Davis** 18B
Own	Unit T	3	Sp.B	Tor-T	Own	Float	4.50-1	34x4½	34x4½	Wood	Cant	Own	Stewart	Plain 3	Ball	Roll	Roll	**Brewster** 1
Own	Unit X	3	Bevel	Tor-A	Own	Semi-F	4.25-1	30x3½	30x3½	Wood†	Ell	Own	Stewart	Plain 2	BR&P	B&R	Ball	**Briscoe** 4-24
Own	Amid	3	Bevel	Springs	West-M	¾ Float	4.08-1	31x4	31x4	Wood	S-E	Jacox	Stewart	Plain 3	Ball	Roll	Ball	**Buick** E-4-34
Own	Amid	3	Bevel	Springs	West-M	¾ Float	4.08-1	31x4	31x4	Wood	S-E	Jacox	Stewart	Plain 3	Ball	Roll	Ball	**Buick** E-4-35
Own	Amid	3	Sp.B	Tor-T	West-M	Float	4.08-1	34x4	34x4	Wood	Cant	Jacox	Stewart	Plain 4	Ball	Roll	Roll	**Buick** E-6-44
Own	Amid	3	Sp.B	Tor-T	West-M	Float	4.08-1	34x4	34x4	Wood	Cant	Jacox	Stewart	Plain 4	Ball	Roll	Roll	**Buick** E-6-45 & 46
Own	Amid	3	Sp.B	Tor-T	West-M	Float	4.61-1	34x4½	34x4½	Wood	Cant	Jacox	Stewart	Plain 4	Ball	Roll	Roll	**Buick** E-6-49 & 50
Own	Unit M	3	Sp.B	Tor-T	Timken	Float	4.43-1 5.07-1	35x5 34x4½	35x5 34x4½	Wood	Plat	Own		Plain 3	BR&P	Roll	Roll	**Cadillac** 57
Muncie	Unit M	3	Bevel	Springs	Salisbury	Float	4.25-1	30x3½	30x3½	Wood	S-E	Own	Van Sicklen	Plain 3	Ball	B&R	Ball	**Campbell**
Grant-Lees	Unit M	3	Sp.B	Springs	Columbia	¾ Float	4.45-1	35x4½	35x4½	Wood†	S-E	Jacox	Stewart	Plain 3	Ball		Roll	**Case** U
Own	Unit M	3	Sp.B	Springs	Timken	Semi-F	4.75-1 5.09-1	32x4 34x4	32x4 34x4	Wood	S-E	Own	Stewart	Plain 3	Roll	Roll	Roll	**Chalmers**
Own	Unit M	3	Sp.B	Tor-T	Own	Float	4.40-1	34x4	34x4	Wood	S-E	Gemmer C. A. S.	Stewart	Plain 3	Ball	Ball	Roll	**Chandler** 25
Own	Amid	3	Bevel	Springs	Own	¾ Float	3.65-1	30x3½	30x3½	Wood	Cant	T.W.Warner	Stewart	Plain 3	B&P	Roll	C&C	**Chevrolet** 490
Own	Amid	3	Bevel	Springs	Own	¾ Float	4.25-1	33x4	33x4	Wood	Cant	T.W.Warner	Stewart	Plain 3	B&P	Roll	C&C	**Chevrolet**
Own	Amid	3	Bevel	Tor-T	Own	¾ Float	4.25-1	34x4	34x4	Wood	Cant	T.W.Warner	Stewart	Plain 3	B&P	Roll	C&C	**Chevrolet** D-4 & D-5
Northway	Unit M	3	Sp.B	Springs	Columbia	Float	4.45-1	35x4½	35x4½	Wood†	S-E	Warner	Warner	Plain 3	Ball	Roll	Roll	**Cole** 870
T.W.Warner	Unit M	3	Sp.B	Tor-T	Timken	¾ Float	4.75-1	32x4	32x4	Opt	Cant	T.W.Warner	Stewart	Plain 3	Ball	Roll	Roll	**Columbia** C&D
Mechanics	Unit M	3	Sp.B	Tor-T	W-Weiss	¾ Float	4.50-1	33x4	33x4	Opt	Cant	C. A. S.	Stewart	Plain 3	Ball	Roll	Ball	**Comet** C-50
Mechanics	Unit M	3	Sp.B	Springs	Peru	Float	4.00-1	32x3½	32x3½	Opt	¾ Ell	Ditwiler	Van Sicklen	Plain 2	Ball	B&R	Ball	**Commonwealth** 4-40
Own	Unit M	3	Sp.B	Springs	Timken	¾ Float	4.08-1	32x4	32x4	Wood	S-E	Gemmer	Stewart	Plain 3	Roll	Roll	Roll	**Crawford** 6-40
Own	Unit M	3	Bevel	Springs	Peru	Float	4.25-1	32x3½	32x3½	Opt	S-E	Jacox	Stewart	Plain 3	Ball	Roll	Roll	**Crow-Elkhart** CE-36
	Unit M	3	Sp.B	Tor-T	Timken	Float	3.08-1 4.08-1	35x5 37x5	35x5 37x5	Opt	¾ Ell	Gemmer	Warner	Plain 3	BR&P	Roll	Roll	**Cunningham**
Brown-Lipe	Unit M	3	Sp.B	Tor-T	Timken	¾ Float	4.45-1	34x4½	34x4½	Wood	S-E	Gemmer	Warner	Plain 3	B&R	Roll	Roll	**Daniels** B
T.W.Warner	Unit M	3	Sp.B	Springs	Columbia	¾ Float	4.58-1	34x4	34x4	Wood	S-E	T.W.Warner	Stewart	Plain 3	B&P	Roll	Ball	**Davis** H, I & K
T.W.Warner	Unit M	3	Sp.B	Springs	Columbia	Float	4.42-1	34x4½	34x4½	Wood	S-E	T.W.Warner	Stewart	Plain 3	B&P	Roll	Roll	**Davis** J & JI
Warner	Unit M	3	Bevel	Springs	American	Float	2.91-1	33x4½	33x4½	Wire	S-E	Warner	Stewart	Plain 3	Roll	Roll	Roll	**Disbrow** A
Own	Amid	4	Chain	Springs	Own	Dead	4.12-1	36x3½	36x3½	Wood	Ell	Foster	Corb.-Brown	Plain	Ball	Ball	Ball	**Dispatch** G
Own	Unit M	3	Sp.B	Tor-T	Own	Float	4.17-1 3.62-1	32x3½	32x3½	Wood†	¾ Ell	Own	Johns-Man	Plain 3	R&P	Roll	Roll	**Dodge**
Own	Unit M	3	Sp.B	Tor-T	Timken	Float	3.50-1	36x4½	36x4½	Wood	Plat	Warner	Warner	Plain 7	Roll	Roll	Roll	**Dorris** I-C
Mechanics	Unit M	3	Bevel	Tor-T	W-Weiss	¾ Float	4.00-1	30x3½	30x3½	Opt	Cant	Jacox	Stewart	Plain 2	B&P	R&P	Ball	**Dort** 11
Mechanics	Unit M	3	Sp.B	Springs	Salisbury	Float	4.50-1	32x3½	32x3½	Wood†	S-E	C. A. S.	Stewart	Plain 2	Ball	Roll	Roll	**Elcar**
Muncie	Unit M	3	Sp.B	Springs	Salisbury	Float	4.50-1	33x4	33x4	Wood†	S-E	C. A. S.	Stewart	Plain 3	Ball	Roll	Roll	**Elcar**
Mechanics	Unit M	3	Sp.B	Tor-A	Adams	¾ Float	4.45-1	32x4	32x4	Wood	Cant	C. A. S.	Van Sicklen	Plain 3	B&P	Ball	Roll	**Elgin** A
Mechanics	Unit M	3	Bevel	Tor-T	Peru	¾ Float	4.33-1 3.75-1	33x4	33x4	Opt	S-E	C. A. S.	Stewart	Plain 3	B&P	B&R	Ball	**Empire** 50-51
Mechanics	Unit M	3	Sp.B	Springs	Hess	Float	4.58-1	34x4	34x4	Opt	S-E	C. A. S.	Stewart	Plain 3	B&P	B&R	Ball	**Empire** 70-A

Splash-Pres—*Splash Pressure*
Spur—*Spur Gears*
T—*T-Head*
Ther—*Thermo-Syphon*
Tor-A—*Torsion Arm*
Tor-R—*Torsion Rod*
Tor-T—*Torsion Tube*
Tr. S-E—*Transverse Semi-Elliptic*
Unit-M—*Unit with Motor*
Unit-T—*Unit with Torque Tube*
Unit-X—*Unit with Axle*
Vib-Dup—*Vibrating Duplex*
†—*Wire Extra*
*—*Two-Speed Axle*

EQUIPMENT

Allis-Ch—*Allis-Chalmers*
At Kent—*Atwater Kent*
A. W. T.—*American Watch Tool Co.*
Continent—*Continental*
Cut-Hammer—*Cutler-Hammer*
G.B.&S.—*Golden, Belknap & Swartz*
G. & D.—*Gray & Davis*
Gen. Elec.—*General Electric*
Hersh-Sp—*Herschell-Spillman*
Johns-Man—*Johns-Manville*
Leece-N—*Leece-Neville*
Longmare—*Longuemare*
Mass-Ph—*Massnick-Phipps*
Mer & Evans—*Merchant & Evans*
Reichbch—*Reichenbach*
Rob-Myers—*Robbins & Myers*
Shkspere—*Shakespeare*
Teet-Hart—*Teetor-Hartley*
U-S-L—*U. S. Light & Heating Corp.*
W-Weiss—*Walker-Weiss*
Ward-L—*Ward Leonard*
West-M—*Weston-Mott*

1918 Passenger Automobiles Listed with

MAKE AND MODEL	Wheelbase	No. of Cylinders	Bore and Stroke, Inches	Piston Displacement, Cubic Inches	Make of Engine	Cylinder Shape	Camshaft Drive	Water Circulation	LUBRICATION		CARBURETION		IGNITION			ELECTRIC SYS.		CLUTCH	
									System	Type of Pump	Make of Carbureter	Fuel Feed	System	Make	Control	Generator Make	Voltage	Make	Type
Empire 71	120	6	3¼x4½	224	Continent.	L.	Helical	Cent.	Splash-Pres.	Piston	Stromberg	Vacuum	Single	Connecticut	Hand	Auto-Lite	6	Borg & Beck	Plate
Empire 73	120	6	3¼x4½	224	Continent.	L.	Helical	Cent.	Splash-Pres.	Piston	Stromberg	Vacuum	Single	Connecticut	Hand	Auto-Lite	6	Borg & Beck	Plate
Fageol	140	6	5 x7	825	Hall-Scott	I.	Bevel	Cent.	Pressure	Gear	Zenith	Vacuum	Dual-D	Splitdorf	Hand	Bosch	12	Hele-Shaw	Disk
Fergus	130	6	3¼x4¾	236	Own	I.	Sp-B	Cent.	Pressure	Gear	Zenith	Vacuum	Single	Bosch	Hand	Special	6	Own	Disk
Fiat E-17	140	4	5¼x6¾	584	Own	L.	Chain	Cent.	Splash-Pres.	Gear	Own	Pressure	2-Pt	Bosch	Hand	Westinghouse	6	Own	Disk
Ford T	100	4	3¾x4	177	Own	L.	Sp-G	Ther.	Splash-Grav.	....	Holley-Kng.	Gravity	Single	Own	Hand	....	...	Own	Disk
Franklin 9	115	6	3¼x4	199	Own	I.	Helical	Air	Pressure	Gear	Own	Vacuum	Single	At Kent	Atmtc	Dyneto	12	Own	Disk
F.R.P. 45B	140	4	4⅝x6¾	445	Own	I.	Helical	Cent.	Splash-Pres.	Piston	Stewart	Pressure	2-Pt	Bosch	Hand	Bosch	12	Mer. & Ev.	Disk
Geronimo	114	4	3½x5	192	Lycoming	L.	Helical	Ther.	Circ-Spl.	....	Carter	Vacuum	Single	Delco	Hand	Dyneto	6	Lycoming	Disk
Geronimo A-45	122	6	3⅛x5	230	Rutenber	L.	Helical	Cent.	Splash-Pres.	Piston	Stromberg	Vacuum	Single	Delco	Hand	Dyneto	6	Borg & Beck	Plate
Ghent 6-60	125	6	3½x5¼	303	Continent.	L.	Helical	Cent.	Splash-Pres.	Piston	Stromberg	Vacuum	Single	Connecticut	Hand	Auto-Lite	6	Borg & Beck	Plate
Glide 6-40	119	6	3⅛x5	230	Rutenber	L.	Helical	Cent.	Splash-Pres.	Piston	Rayfield	Vacuum	Single	Westinghouse	Hand	Westinghouse	6	Own	Disk
Grant G	114	6	3 x4¼	180	Own	I.	Helical	Ther.	Circ-Spl.	Piston	Stromberg	Vacuum	Single	Remy	Atmtc	Wagner	6	Durston	Cone
Hackett A L	112	4	3¾x4¼	188	Own	L.	Chain	Ther.	Splash-Pres.	Piston	Dave Buick	Vacuum	Single	Connecticut	Hand	Dyneto	6	....	Disk
Hal 21-A	135	12	2⅞x5	389	Weidely	I.	Helical	Cent.	Pressure	Gear	Stromberg	Vacuum	Dual	Remy	Hand	Westinghouse	6	Borg & Beck	Plate
Harroun	106	4	3¼x5¼	174	Own	I.	Helical	Ther.	Circ-Spl.	Piston	Stromberg	Vacuum	Single	At Kent	Hand	Remy	6	Own	Cone
Harvard 4-20	100	4	3x4¼	120	Sterling	I.	Helical	Ther.	Circ-Spl.	Gear	Zenith	Gravity	Single	At Kent	Atmtc	Wagner	6	Detroit	Cone / Disk
Haynes 38	121	6	3½x5	289	Own	L.	Helical	Cent.	Circ-Spl.	Piston	Rayfield	Vacuum	Single	Remy	Hand	Leece-N	6	Borg & Beck	Plate
Haynes 39	127	6	3½x6	346	Own	L.	Helical	Cent.	Circ-Spl.	Piston	Rayfield	Vacuum	Single	Remy	Hand	Leece-N	6	Borg & Beck	Plate
Haynes 44	127	12	2¾x5	356	Own	I.	Chain	Cent.	Pressure	Gear	Rayfield	Vacuum	Single	Delco	H&A.	Leece-N	6	Borg & Beck	Plate
Hollier 196	116	6	3 x4¼	180	Falls	I.	Helical	Ther.	Circ-Spl.	Gear	Stewart	Vacuum	Single	Remy	Hand	Splitdorf	12	Own	Cone
Hollier 206	116	6	3¼x4½	224	Continent.	L.	Helical	Cent.	Splash-Pres.	Gear	Stewart	Vacuum	Single	Remy	Hand	Splitdorf	12	Borg & Beck	Plate
Hollier 188	116	8	3 x4¼	180	Own	L.	Helical	Ther.	Pressure	Gear	Stewart	Vacuum	Single	At Kent	Atmtc	Splitdorf	12	Own	Cone
Homer-Laughlin D	112	8	2¼x3¾	117	Own	...	Chain	Ther.	Circ-Spl.	....	Zenith	....	Single	At Kent	Atmtc	Disco	12	Own	....
Hudson	125	6	3½x5	289	Own	L.	Helical	Cent.	Circ-Spl.	Piston	Own	Vacuum	Single	Delco	H&A.	Delco	6	Own	Disk
Hupmobile R	112	4	3¼x5½	182	Own	L.	Chain	Ther.	Pressure	Gear	Stromberg	Vacuum	Single	At Kent	Hand	Bijur	6	Own	Disk
Inter-State T	110	4	3½x5	192	Beaver	I.	Helical	Ther.	Circ-Spl.	Gear	Schebler	Gravity	Single	Remy	Hand	Remy	6	Own	Cone
Jackson	118	8	3 x3½	198	Ferro	I.	Helical	Ther.	Pressure	Gear	Zenith	Vacuum	Single	Remy	S-A.	Auto-Lite	6	Borg & Beck	Plate
Jones 26 AB	125	6	3½x5⅛	296	Lewis	L.	Helical	Cent.	Circ-Spl.	Piston	Stromberg	Vacuum	Single	Remy	Hand	Auto-Lite	6	Borg & Beck	Plate
Jordan J-60	127	6	3½x5¼	303	Continent.	L.	Helical	Cent.	Splash-Pres.	Piston	Stromberg	Vacuum	Single	Bosch	Hand	Bijur	6	Brown-Lipe	Disk
King EE	120	8	3 x5	283	Own	L.	Chain	Ther.	Pressure	Gear	Ball	Vacuum	Single	At Kent	Hand	Bijur	6	Borg & Beck	Plate
Kissel	117	6	3¼x5	249	Own	L.	Helical	Cent.	Splash-Pres.	Gear	Stromberg	Vacuum	Single	Remy	Hand	Remy	6	T.W.Warner	Cone
Kissel	128	12	2⅜x5	259	Weidely	I.	Helical	Cent.	Pressure	Gear	Stromberg	Vacuum	Single	Delco	H&A.	Delco	6	Warner	Disk
Kline 6-38	120	6	3¼x4½	224	Continent.	L.	Helical	Cent.	Splash-Pres.	Piston	Rayfield	Vacuum	Single	Westinghouse	Hand	Westinghouse	6	Borg & Beck	Plate
Lexington R	122	6	3¼x4½	224	Continent.	L.	Helical	Cent.	Circ-Spl.	Piston	Rayfield	Vacuum	Single	Connecticut	Hand	Westinghouse	6	Borg & Beck	Plate
Liberty 10-B	115	6	3¼x4½	224	Continent.	L.	Helical	Ther.	Splash-Pres.	Piston	Stromberg	Vacuum	Single	Delco	Hand	Delco	6	Borg & Beck	Plate
Locomobile 38	139	6	4¼x5	426	Own	T.	Helical	Cent.	Splash-Pres.	Gear	Ball	Pressure	Dual-D	Berling	Hand	Westinghouse	6	Own	Disk
Locomobile 48	142	6	4½x5½	525	Own	T.	Helical	Cent.	Splash-Pres.	Gear	Ball	Pressure	Dual-D	Berling	Hand	Westinghouse	6	Own	Disk
Madison	120	6	3⅛x5	230	Rutenber	L.	Helical	Cent.	Splash-Pres.	Piston	Rayfield	Vacuum	Single	Remy	Hand	Remy	6	Muncie	Disk
Madison	124	6	3⅛x5	230	Rutenber	L.	Helical	Cent.	Circ-Spl.	Piston	Rayfield	Vacuum	Single	Remy	Hand	Remy	6	Muncie	Disk
Maibohm A	105	4	3⅛x4	123	Own	L.	Helical	Ther.	Splash-Pres.	Piston	Zenith	Gravity	Single	At Kent	Atmtc	Disco	12	Mechanics	Disk
Maibohm B	115	6	3⅛x4¼	196	Falls	I.	Helical	Ther.	Splash-Pres.	Piston	Stromberg	Vacuum	Single	At Kent	Hand	Wagner	6	Borg & Beck	Plate
Marion-Handley A	120	6	3⅛x5	230	Rutenber	L.	Helical	Cent.	Circ-Spl.	Piston	Stromberg	Vacuum	Single	At Kent	Hand	Westinghouse	6	....	Disk
Marion-Handley B	125	6	3½x5¼	303	Continent.	L.	Helical	Cent.	Splash-Pres.	Piston	Stromberg	Vacuum	Single	Westinghouse	Hand	Westinghouse	6	....	Disk
Marmon 34	136	6	3¾x5⅛	340	Own	I.	Helical	Cent.	Pressure	Gear	Stromberg	Gravity	Single	Bosch	Hand	Bijur	6	Own	Cone
Maxwell 25	109	4	3⅝x4½	170	Own	L.	Helical	Ther.	Splash-Pres.	Piston	K. D.	Gravity	Single	At Kent	Hand	Simms-Huff.	12	Own	Cone
McFarlan X	136	6	4½x6	572	Teet-Hart.	T.	Helical	Cent.	Splash-Pres.	Piston	Stromberg	Vacuum	Double	Eisemann	Hand	Westinghouse	6	Borg & Beck	Plate
Mercer	115	4	3¾x6¾	298	Own	L.	Chain	Cent.	Pressure	Gear	Zenith	Vacuum	Single	Bosch	Hand	U-S-L	...	Own	Disk
Mercer	132	4	3¾x6¾	298	Own	L.	Chain	Cent.	Pressure	Gear	....	Vacuum	Single	....	Hand	....	...	Own	Disk
Metz 25	108	4	3⅞x4	189	Own	L.	Helical	Ther.	Circ-Spl.	Gear	A.W.T.	Gravity	Single	At Kent	Fixed	Westinghouse	6	Own	....

ABBREVIATIONS

2-pt—*Two Point*
¾ Ell—*¾ Elliptic*
¾ Float—*¾ Floating*
¾ Plat—*¾ Platform*
Amid—*Amidships*
Atmtc—*Automatic*
B & P—*Ball and Plain*
B & R—*Ball and Roller*
B R & P—*Ball, Roller and Plain*
C & C—*Cup and Cone*
Cant—*Cantilever*
Cent—*Centrifugal*
Circ-Spl—*Circulating Splash*
Dual-D—*Dual Double*
Ell—*Elliptic*
F—*F-Head*
Float—*Floating*
Fric—*Friction*
Gear—*Gear Pump*
H—*Horizontal*
H & A—*Hand and Automatic*
I—*I-Head*
Imp—*Impeller*
K—*Knight type*
L—*L-Head*
Mag—*Magnetic*
Non-Spl—*Non-Circulating Splash*
Opt—*Optional*
Plan—*Planetary*
Plat—*Platform*
Rad-Rd—*Radius Rods*
Rev-C—*Reversed Cone*
Roll—*Roller*
S-A—*Semi-Automatic*
S-E—*Semi-Elliptic*
Semi-F—*Semi-Floating*
Sp.B—*Spiral Bevel*
Sp.G—*Spiral Gear*

Their Technical Specifications—Continued

Transmission: Gearset: Make	Transmission: Gearset: Location	Transmission: Gearset: Forward Speeds	Transmission: Final Drive	Transmission: Torque Taken By	Transmission: Make of Rear Axle	Transmission: Rear Axle Type	Gear Ratio on Direct	Running Gear: Tires: Front	Running Gear: Tires: Rear	Running Gear: Wheels	Running Gear: Rear Spr'gs	Make of Steering Gear	Make of Speed-ometer	Crank-shaft Bearings and Number	Bearings: Gearset	Bearings: Rear Axle	Bearings: Front Wheel	Make and Model
Mechanics	Unit M	3	Bevel	Tor-T	West-M	¾ Float	4.00-1	34x4	34x4	Opt	¾ Ell	C. A. S.	Stewart	Plain 3	B&P	B&R	Ball	Empire 71
Mechanics	Unit-M	3	Sp.B	Springs	Hess	Float	4.58-1	34x4	34x4	Opt	S-E	C. A. S.	Stewart	Plain 3	B&P	B&R	Ball	Empire 73
Own	Amid	3	Bevel	Springs	Own	Semi-F	1.50-1	34x4½	34x4½	Wire	S-E	Gemmer	Stewart	Plain 7	Ball	Roll	Roll	Fageol
Own	Amid	3	Sp.B	Tor-T	Own	Semi-F	4.00-1 / 4.75-1	33x4½	33x4½	Opt	Cant	Own		Plain 3	Plain	B&P	Ball	Fergus
Own	Amid	4	Sp.B	Tor-T	Own	Semi-F	2.75-1	35x5	35x5	Wood	S-E	Own	Stewart	Plain 3	Plain	Ball	Ball	Fiat E-17
Own	Plan	2	Bevel	Tor-T / Rad-Rd	Own	Semi-F	3.64-1	30x3	30x3½	Wood	Tr.S-E	Own	None	Plain 3	Plain	Roll	Ball	Ford T
Own	Amid	3	Sp.B	Springs	Own	Semi-F	4.33-1	32x4 / 33x4½	32x4 / 33x4½	Wood	Ell	Own	Stewart	Plain 7	Ball	Ball	Ball	Franklin 9
Own	Amid	4	Bevel	Tor-T	Own	Float	3.00-1	36x4½	36x5	Wire	S-E	Own	Opt	Plain 3	Ball	Ball	Ball	F.R.P 45B
Mechanics	Unit M	3	Bevel	Tor-T	Adams	Float	4.00-1	32x3½	32x3½	Wood	Cant	C. A. S.	Stewart	Plain 2	Plain	Ball	Ball	Geronimo
Dundore	Unit M	3	Sp.B	Springs	W-Weiss	¾ Float	4.50-1	32x4	32x4	Wood	S-E	C. A. S.	Stewart	Plain 3	Ball	Roll	Ball	Geronimo A-45
Grant-Lees	Unit M	3	Sp.B	Springs	Standard	¾ Float	4.33-1	34x4	34x4	Opt	S-E	Lavine	Stewart	Plain 3	Ball	B&R	Roll	Ghent 6-60
Own	Unit-M	3	Sp.B	Springs	American	¾ Float	4.64-1	34x4	34x4	Wood	¾ El	Lavine	Stewart	Plain 3	B&P	Ball	Ball	Glide 6-40
Durston	Unit M	3	Bevel	Tor-T	Peru	Float	4.50-1	32x3½	32x3½	Opt	Cant	Jacox	Van Sicklen	Plain 3	B&P	B&R	Roll	Grant G
Grant-Lees	Unit M	3	Bevel	Springs	W-Weiss	Semi-F	4.00-1	32x3½	32x3½	Wood	¾ Ell	Jacox	Stewart	Plain 3	Ball	Roll	Ball	Hackett A L
Grant-Lees	Unit M	3	Sp.B	Springs	Timken	Float	4.45-1	34x4½	34x4½	Wood†	S-E	Gemmer	Van Sicklen	Plain 3	B&R	Roll	Roll	Hal 21-A
Mechanics	Unit M	3	Bevel	Tor-T	Own	¾ Float	4.00-1	30x3½	30x3½	Wood	Cant	C. A. S.	Stewart	Plain 3	B&P	B&R	Roll	Harroun
Detroit	Unit M	3	Bevel	Springs	Detroit	Semi-F	4.00-1	28x3	28x3	Opt	Cant	Barnes	Stewart	Plain 3	B&P	B&R	Ball	Harvard 4-20
Own	Unit M	3	Sp.B	Springs	Own	¾ Float	4.42-1	34x4	34x4	Wood	S-E	Jacox	Stewart	Plain 3	Ball	Ball	Ball	Haynes 38
Own	Unit M	3	Sp.B	Springs	Own	¾ Float	4.42-1	35x4½	35x4½	Wood	S-E	Jacox	Stewart	Plain 3	B&P	B&P	Ball	Haynes 39
Own	Unit M	3	Sp.B	Springs	Own	¾ Float	4.07-1	34x4½	34x4½	Wire	S-E	Jacox	Warner	Plain 3	Ball	Ball	Ball	Haynes 44
Own	Unit M	2	Sp.B	Tor-T	Own	Float	4.50-1	32x3½	32x3½	Wood	Cant	Own	Stewart	Plain 3	Ball	Ball	Ball	Hollier 196
Own	Unit M	3	Sp.B	Tor-T	Own	Float	4.50-1	32x4	32x4	Wood†	Cant	Own	Stewart	Plain 3	Ball	Ball	Ball	Hollier 206
Own	Unit-M	2	Sp.B	Tor-T	Own	Float	4.50-1	34x4	34x4	Wood	Cant	Own	Stewart	Plain 3	Ball	Ball	Ball	Hollier 188
Friction	Amid	....	Chain	Rad-Rd	Own	Dead	......	30x3½	30x3½	Wire	Cant	Warner	Stewart	Ball 2	Ball	Ball	Ball	Homer-Laughlin D
Own	Unit M	3	Sp.B	Springs	Timken	¾ Float	*4.08-1	34x4	34x4	Wood†	S-E	Gemmer	Stewart	Plain 4	Roll	Roll	Roll	Hudson
Own	Unit M	3	Sp.B	Springs	Own	¾ Float	4.91-1	32x4	32x4	Wood	S-E	Jacox	Van Sicklen	Plain 3	B&P	Roll	Ball	Hupmobile R
Durston	Unit X	3	Bevel	Tor-T	Peru	¾ Float	4.00-1	33x4	33x4	Opt	¾ Ell	T.W.Warner	Stewart	Plain 3	B&R	Roll	Ball	Inter-State T
Covert	Unit M	3	Sp.B	Springs	Salisbury	¾ Float	5.27-1	37x4	37x4	Wood	Ell	Foster	Stewart	Plain 3	Roll	Roll	Ball	Jackson
Covert	Unit M	3	Sp.B	Springs	Timken	¾ Float	4.45-1	34x4	34x4	Wood	S-E	T.W.Warner	Stewart	Plain 3	Roll	Roll	Roll	Jones 26 AB
Brown-Lipe	Unit M	3	Sp.B	Springs	Timken	Semi-F	4.45-1	35x4½	35x4½	Wood	S-E	Gemmer	Van Sicklen	Plain 3	B&P	Roll	B&R	Jordan J-60
Own	Unit M	3	Sp.B	Tor-A	Columbia	Float	4.58-1	34x4	34x4	Wood	Cant	Jacox	Stewart	Plain 3	BR&P	Roll	Roll	King EE
T.W.Warner	Unit M	3	Sp.B	Springs	Own	Float	4.58-1	34x4	34x4	Wood	¾Ell	Jacox	Stewart	Plain 3	R&P	Roll	Roll	Kissel
Warner	Unit M	3	Sp.B	Springs	Own	Float	4.58-1	34x4½	34x4½	Wood	¾ Ell	Jacox	Stewart	Plain 3	B&R	Roll	Roll	Kissel
Grant-Lees	Unit M	3	Sp.B	Springs	Hess	Float	4.33-1	34x4	34x4	Wood†	¾ Ell	Lavine	Stewart	Plain 3	Ball	Roll	Roll	Kline 6-38
Warner	Unit M	3	Sp.B	Springs	Hess	¾Float	5.00-1	34x4	34x4	Wood†	S-E	Warner	Stewart	Plain 3	Ball	Roll	Ball	Lexington R
Detroit	Unit M	3	Sp.B	Springs	Timken	Semi-F	4.75-1	32x4	32x4	Wood	S-E	Warner	Stewart	Plain 3	Ball	Roll	Roll	Liberty 10-B
Own	Amid	4	Sp.B	Tor-T	Own	Float	3.85-1	36½x4½	37x5	Wood	¾ Ell	Own	Warner	Plain 7	Ball	Ball	Roll	Locomobile 38
Own	Amid	4	Sp.B	Tor-A	Own	Float	3.85-1	37x5	37x5	Wood	¾ Ell	Own	Warner	Plain 7	Ball	Ball	Roll	Locomobile 48
Muncie	Unit M	3	Sp.B	Springs	Salisbury	¾ Float	4.42-1	34x4	34x4	Wood	¾ Ell	Warner	Stewart	Plain 3	B&P	Ball	Ball	Madison
Muncie	Unit M	3	Sp.B	Springs	Salisbury	¾ Float	4.42-1	34x4	34x4	Wood	¾ Ell	Warner	Stewart	Plain 3	B&P	Ball	Ball	Madison
Mechanics	Unit M	3	Sp.B	Springs	W-Weiss	Float	4.25-1	30x3½	30x3½	Opt	S-E	Jacox	Stewart	Plain 2	Ball	Roll	Ball	Maibohm A
Mechanics	Unit M	3	Sp.B	Springs	Peru	Float	4.25-1	32x3½	32x3½	Opt	S-E	Jacox	Stewart	Plain 3	Ball	Roll	Ball	Maibohm B
Muncie	Unit M	3	Sp.B	Springs	Salisbury	Float	4.41-1	32x4	34x4	Wood†	S-E	Warner	Stewart	Plain 3	B&P	Roll	Ball	Marion-Handley A
Muncie	Unit M	3	Sp.B	Springs	Salisbury	Float	4.07-1	35x4½	35x4½	Wood†	S-E	Warner	Stewart	Plain 3	Ball	Roll	Ball	Marion-Handley B
Own	Unit T	3	Sp.B	Tor-T	Own	¾ Float	3.69-1	32x4½	32x4½	Wire	Brush	Gemmer	Van Sicklen	Plain 4	BR&P	B&R	Roll	Marmon 34
Own	Unit M	3	Bevel	Tor-T	Own	¾ Float	3.58-1	30x3½	30x3½	Opt	S-E	Own	Stewart	Plain 2	R&P	Roll	Ball	Maxwell 25
Brown-Lipe	Amid	3	Sp.B	Springs	Timken	Float	3.50-1	35x5	35x5	Opt	S-E	Warner	Warner	Plain 4	Roll	Roll	Roll	McFarlan X
Own	Amid	4	Sp.B	Springs	Own	Float	3.22-1	32x4	32x4	Wire	S-E			Plain 3	Ball	Roll	Roll	Mercer
Own	Amid	4	Sp.B	Springs	Own	Float	3.87-1	32x4½	32x4½	Wire	S-E			Plain 3	Ball	B&R	Roll	Mercer
Friction	....	7	Chain	Springs	Own	......	......	32x3½	32x3½	Opt	Ell	Own	Stewart	Plain 3	......	Roll	Ball	Metz 25

Splash-Pres—*Splash Pressure*
Spur—*Spur Gears*
T—*T-Head*
Ther—*Thermo-Syphon*
Tor-A—*Torsion Arm*
Tor-R—*Torsion Rod*
Tor-T—*Torsion Tube*
Tr S-E—*Tranverse Semi-Elliptic*
Unit-M—*Unit with Motor*
Unit-T—*Unit with Torque Tube*
Unit-X—*Unit with Axle*
Vib-Dup—*Vibrating Duplex*
†—*Wire Extra*
*—*Also available* 4.45-1, 3.80-1 and 4.90-1

EQUIPMENT

Allis-Ch—*Allis-Chalmers*
At Kent—*Atwater Kent*
A. W. T.—*American Watch Tool Co.*
Continent—*Continental*
Cut-Hammer—*Cutler-Hammer*
G.B.&S.—*Golden, Belknap & Swartz*
G. & D.—*Gray & Davis*
Gen. Elec.—*General Electric*
Hersh-Sp—*Herschell-Spillman*
Johns-Man—*Johns-Manville*
Leece-N—*Leece-Neville*
Longmare—*Longuemare*
Mass-Ph—*Massnick-Phipps*
Mer & Evans—*Merchant & Evans*
Reichbch—*Reichenbach*
Rob-Myers—*Robbins & Myers*
Shkspere—*Shakespeare*
Teet-Hart—*Teetor-Hartley*
U-S-L—*U. S. Light & Heating Corp.*
W-Weiss—*Walker-Weiss*
Ward-L—*Ward Leonard*
West-M—*Weston-Mott*

1918 Passenger Automobiles Listed with

MAKE AND MODEL	Wheel-base	No. of Cylinders	Bore and Stroke, Inches	Piston Displacement, Cubic Inches	Make of Engine	Cylinder Shape	Cam-shaft Drive	Water Circulation	LUBRICATION System	LUBRICATION Type of Pump	CARBURETION Make of Carbureter	CARBURETION Fuel Feed	IGNITION System	IGNITION Make	IGNITION Control	ELECTRIC SYS. Generator Make	ELECTRIC SYS. Voltage	CLUTCH Make	CLUTCH Type
Mitchell D-40	120	6	3¼x5	249	Own	L.	Helical	Cent.	Splash-Pres.	Piston	Rayfield	Vacuum	Single	Connecticut	Hand	Splitdorf	6	Own	Cone
Mitchell C-42	127	6	3½x5	289	Own	L.	Helical	Cent.	Splash-Pres.	Piston	Stromberg	Vacuum	Single	Connecticut	Hand	Westinghouse	6	Own	Cone
Moline-Knight C	118	4	3¾x5	221	Own	K.	Chain	Ther.	Pressure	Gear	Schebler	Vacuum	Single	Connecticut	Hand	Wagner	6	Own	Cone
Moline-Knight G	122	4	4 x6	302	Own	K.	Chain	Ther.	Pressure	Gear	Schebler	Vacuum	Single	Connecticut	Hand	Wagner	6	Own	Cone
Moniter	117	6	3¼x4½	224	Continent.	L.	Helical	Cent.	Splash-Pres.	....	Stromberg	Vacuum	Dual	Heinze	Hand	Heinze	6	Borg & Beck	Plate
Monroe M-3	96	4	3 x4¼	120	Sterling	I.	Helical	Ther.	Circ-Spl.	Piston	Zenith	Vacuum	Single	Connecticut	Hand	Auto-Lite	6	Mechanics	Disk
Monroe M-6	115	4	3¼x4½	149	Own	I.	Helical	Ther.	Splash-Pres.	Gear	Zenith	Vacuum	Single	Connecticut	Hand	Auto-Lite	6	Mechanics	Disk
Moon 6-36	114	6	2¾x4½	165	Continent.	L.	Helical	Ther.	Splash-Pres.	Piston	Tillotson	Gravity	Single	Delco	Hand	Wagner	6	Detlaff	Disk
Moon 6-45	125	6	3¼x4½	224	Continent.	L.	Helical	Cent.	Splash-Pres.	Piston	Rayfield	Vacuum	Single	Delco	Hand	Delco	6	Borg & Beck	Plate
Moon 6-66	125	6	3½x5¼	303	Continent.	L.	Helical	Cent.	Splash-Pres.	Piston	Rayfield	Vacuum	Single	Delco	Atmtc	Delco	6	Borg & Beck	Plate
Moore 30-E	106	4	3¾x4¼	188	G.B.& S.	L.	Chain	Ther.	Splash-Pres.	Piston	Schebler	Gravity	Single	....	Hand	Dyneto	6	G.B. & S.	Disk
Moore 30	108	4	3¾x4¼	188	G.B.& S.	L.	Chain	Ther.	Circ-Spl.	Piston	Schebler	Vacuum	Single	Splitdorf	Hand	Dyneto	6	G.B. & S.	Disk
Murray	128	8	3¼x5	332	Hersh-Sp.	L.	Helical	Cent.	Pressure	Gear	Zenith	Vacuum	Single	Splitdorf	Hand	Westinghouse	6	Borg & Beck	Plate
Nash 681-683	121	6	3¼x5	249	Own	I.	Helical	Cent.	Splash-Pres.	Gear	Marvel	Vacuum	Single	Delco	H&A.	Delco	6	Borg & Beck	Plate
Nash 671	125	6	3½x4⅝	267	Own	L.	Chain	Cent.	Splash-Pres.	Gear	Rayfield	Vacuum	Single	Delco	Hand	Bijur	6	Borg & Beck	Plate
Nash 684	127	6	3¼x5	249	Own	I.	Helical	Cent.	Splash-Pres.	Gear	Marvel	Vacuum	Single	Delco	H&A.	Delco	6	Borg & Beck	Plate
National	128	6	3½x5¼	303	Own	L.	Helical	Cent.	Splash-Pres.	Gear	Rayfield	Vacuum	Single	Splitdorf	Hand	Westinghouse	6	Own	Cone
National	128	12	2⅞x4¾	370	Own	L.	Helical	Cent.	Pressure	Gear	Rayfield	Vacuum	Single	Delco	Hand	Bijur	6	Own	Cone
Nelson	104	4	3¼x4⅜	146	Own	I.	Helical	Ther.	Pressure	Gear	Zenith	Vacuum	Single	Bosch	Hand	U-S-L	12	Own	Disk
Oakland 34B	112	6	2 13/16x4¾	177	Northway	I.	Helical	Cent.	Splash-Pres.	Gear	Marvel	Vacuum	Single	Remy	Hand	Remy	6	Northway	Cone
Oldsmobile 37	112	6	2 13/16x4¾	177	Northway	I.	Helical	Cent.	Pressure	Gear	Johnson	Vacuum	Single	Remy	Hand	Remy	6	Northway	Cone
Oldsmobile 45A	120	8	2⅞x4¾	247	Own	L.	Helical	Cent.	Pressure	Gear	Ball	Vacuum	Single	Delco	H&A.	Delco	6	Own	Cone
Olympian	114	4	3¼x4½	149	Own	I.	Helical	Ther.	Pressure	Gear	Stromberg	Vacuum	Single	Remy	Hand	Wagner	6	Own	Disk
Overland 85	112	4	4⅛x4½	240	Own	L.	Helical	Ther.	Circ-Spl.	Gear	Tillotson	Vacuum	Single	....	Hand	Auto-Lite	6	Auto-Lite	Cone
Overland 90	104 / 106	4	3⅜x5	178	Own	L.	Helical	Ther.	Circ-Spl.	Piston	Tillotson	Vacuum	Single	....	Hand	Auto-Lite	6	Auto-Lite	Cone
Overland 85	116	6	3¼x4½	224	Continent.	L.	Helical	Cent.	Splash-Pres.	Piston	Tillotson	Vacuum	Single	....	Hand	Auto-Lite	6	Auto-Lite	Cone
Owen Magnetic W-42	142	6	4 x5½	415	Own	I.	Sp-G.	Cent.	Pressure	Gear	Zenith	Vacuum	Single	Bosch	Hand	Own	24	....	......
Packard 3-25 & 3-35	128 / 136	12	3 x5	424	Own	L.	Chain	Cent.	Pressure	Gear	Own	Pressure	Single	Delco	H&A.	Bijur	6	Own	Plate
Paige 6-39	117	6	3⅛x5	230	Rutenber	L.	Helical	Cent.	Splash-Pres.	Piston	Stromberg	Gravity	Single	Remy	Hand	G&D	6	Borg & Beck	Plate
Paige 6-55	127	6	3½x5¼	303	Continent.	L.	Helical	Cent.	Splash-Pres.	Piston	Rayfield	Vacuum	Single	Remy	Hand	Remy	6	Borg & Beck	Plate
Pan American G-5	120	6	3⅛x5	230	Rutenber	L.	Helical	Cent.	Splash-Pres.	Piston	Rayfield	Vacuum	Single	G&D	Hand	G&D	6	Borg & Beck	Plate
Pan American J-7	128	6	3½x5¼	303	Continent.	L.	Helical	Cent.	Splash-Pres.	Piston	Rayfield	Vacuum	Single	Bosch	Hand	G&D	6	Borg & Beck	Plate
Paterson 6-45	120	6	3¼x4½	224	Continent.	L.	Helical	Cent.	Splash-Pres.	Piston	Stromberg	Vacuum	Dual	Delco	Hand	Delco	6	Detroit	Cone
Peerless 56	125	8	3¼x5	332	Own	L.	Helical	Cent.	Pressure	Gear	Ball	Vacuum	Single	At Kent	H&A.	Auto-Lite	6	Brown-Lipe.	Disk
Pennsy	115	4	3¾x4½	199	G.B.& S.	L.	Chain	Ther.	Pressure	Piston	Carter	Vacuum	Single	Connecticut	Hand	Dyneto	6	G.B. & S.	Disk
Pennsy	120	6	3¼x4½	224	Continent.	L.	Helical	Cent.	Splash-Pres.	Gear	Rayfield	Vacuum	Single	....	Hand	Heinze	6	Borg & Beck	Plate
Phianna M	....	4	3 15/16x6	287	Own	L.	Chain	Cent.	Pressure	Gear	H & N.	Vacuum	Single	Bosch	Hand	Ward-L.	6	....	Disk
Pierce-Arrow C-4	134	6	4 x5½	415	Own	T.	Helical	Cent.	Pressure	Gear	Own	Pressure	Double	Bosch, West.	Hand	Westinghouse	6	Own	Cone
Pierce-Arrow B-4	142	6	4½x5½	525	Own	T.	Helical	Cent.	Pressure	Gear	Own	Pressure	Double	Bosch, West.	Hand	Westinghouse	6	Own	Cone
Pierce-Arrow A-4	147½	6	5 x7	825	Own	T.	Helical	Cent.	Pressure	Gear	Own	Pressure	Double	Bosch, West.	Hand	Westinghouse	6	Own	Cone
Pilot 6-45	119	6	3⅛x5	230	Teet-Hart	L.	Helical	Cent.	Splash-Pres.	Piston	Tillotson	Vacuum	Single	Delco	Hand	Delco	6	Borg & Beck	Plate
Premier 6-C	125½	6	3⅜x5½	295	Own	I.	Helical	Cent.	Splash-Pres.	Gear	Johnson	Vacuum	Single	Delco	H&A.	Delco	6	Borg & Beck	Plate
Princess 36-F	108	4	3¾x4¼	188	G.B. & S.	L.	Chain	Ther.	Circ-Spl.	Piston	Schebler	Vacuum	Single	Splitdorf	Hand	Disco	6	....	Disk
Regal J	108	4	3½x4¼	163	Own	L.	Helical	Ther.	Circ-Spl.	Piston	Carter	Vacuum	Single	At Kent	Hand	Auto-Lite	6	Own	Cone
Reo R	115	4	4⅛x4½	240	Own	F.	Helical	Cent.	Circ-Spl.	Piston	Johnson	Vac.-Gra.	Single	Remy	Hand	Remy	6	Own	Disk
Reo M	126	6	3 9/16x5⅛	307	Own	F.	Helical	Cent.	Circ-Spl.	Piston	Rayfield	Vacuum	Single	Remy	Hand	Remy	6	Own	Disk
Roamer D-4-75	128	4	4 x6	302	Dues'nb'rg	H.	Helical	Cent.	Splash-Pres.	Gear	Stromberg	Vacuum	Single	Bosch	Hand	Bijur	6	Borg & Beck	Plate
Roamer C-6-54	128	6	3½x5¼	303	Continent.	L.	Helical	Cent.	Splash-Pres.	Piston	Stromberg	Vacuum	Single	Bosch	Hand	Bijur	6	Borg & Beck	Plate
Roamer D-6-90	138	6	3¾x5¾	381	Dues'nb'rg	H.	Chain	Cent.	Splash-Pres.	Gear	Stromberg	Vacuum	Single	Bosch	Hand	Bijur	6	Fuller	Disk
Saxon B-5	96	4	2¾x4	95	Continent.	L.	Helical	Ther.	Circ-Spl.	Piston	Schebler	Gravity	Single	At Kent	Atmtc	Wagner	6	Own	Plate
Saxon S-4	112	6	2⅞x4½	175	Continent.	L.	Helical	Ther.	Circ-Spl.	Piston	Stromberg	Gravity	Single	Remy	Hand	Wagner	6	Own	Plate
Sayers	118	6	3¼x4½	224	Continent.	L.	Helical	Cent.	Splash-Pres.	Piston	Zenith	Vacuum	Single	Delco	Hand	Delco	6	Borg & Beck	Plate
Scripps-Booth G	110	4	3 11/16x4	171	Mason	I.	Helical	Cent.	Splash-Pres.	Gear	Zenith	Vacuum	Single	Remy	Atmtc	Remy	6	Mason	Cone

ABBREVIATIONS

2-pt—*Two Point*
¾ Ell—¾ *Elliptic*
¾ Float—¾ *Floating*
¾ Plat—¾ *Platform*
Amid—*Amidships*
Atmtc—*Automatic*
B & P—*Ball and Plain*
B & R—*Ball and Roller*
B R & P—*Ball, Roller and Plain*
C & C—*Cup and Cone*
Cant—*Cantilever*
Cent—*Centrifugal*
Circ-Spl—*Circulating Splash*
Dual-D—*Dual Double*
Ell—*Elliptic*
F—*F-Head*
Float—*Floating*
Fric—*Friction*
Gear—*Gear Pump*
H—*Horizontal*
H & A—*Hand and Automatic*
I—*I-Head*
Imp—*Impeller*
K—*Knight type*
L—*L-Head*
Mag—*Magnetic*
Non-Spl—*Non-Circulating Splash*
Opt—*Optional*
Plan—*Planetary*
Plat—*Platform*
Rad-Rd—*Radius Rods*
Rev-C—*Reversed Cone*
Roll—*Roller*
S-A—*Semi-Automatic*
S-E—*Semi-Elliptic*
Semi-F—*Semi-Floating*
Sp.B—*Spiral Bevel*
Sp.G—*Spiral Gear*

Their Technical Specifications—Continued

TRANSMISSION: Gearset Make	Gearset Location	Gearset Forward Speeds	Final Drive	Torque Taken By	Make of Rear Axle	Rear Axle Type	Gear Ratio on Direct	RUNNING GEAR: Tires Front	Tires Rear	Wheels	Rear Spr'gs	Make of Steering Gear	Make of Speed-ometer	Crank-shaft Bearings and Number	BEARINGS: Gearset	Rear Axle	Front Wheel	MAKE AND MODEL
Own	Unit T	3	Sp.B.	Tor-T	Own	¾ Float	4.25-1	32x4	32x4	Wood	Cant.	Own	Stewart	Plain 3	B&R	B&R	Roll	Mitchell D-40
Own	Unit T	3	Sp.B.	Tor-T	Own	Float	4.25-1	34x4	34x4	Wood	Cant.	Own	Stewart	Plain 3	B&R	Roll	Roll	Mitchell C-42
Warner	Amid	3	Sp.B.	Tor-A	Timken	Semi-F	4.90-1	34x4	34x4	Wood	Brush.	Jacox	Stewart	Plain 3	Roll	Roll	Roll	Moline-Knight C
Warner	Amid	3	Sp.B.	Tor-A	Timken	Semi-F	4.00-1	35x4½	35x4½	Wood	Brush.	Jacox	Stewart	Plain 3	Roll	Roll	Roll	Moline-Knight G
Grant-Lees	Unit M	3	Bevel	Springs	Adams	Float	4.08-1 / 4.50-1	33x4	33x4	Wood	¾ Ell	Foster	Stewart	Plain	Ball	B&R	......	Monitor
Mechanics	Unit M	3	Sp.B.	Tor-T	W-Weiss	¾ Float	4.00-1	30x3 / 31x3½	30x3 / 31x3½	Wood	S-E	Jacox	Stewart	Plain 2	Ball	Ball	B&R	Monroe M-3
Mechanics	Unit M	3	Sp.B.	Tor-T	Hess	Semi-F	4.80-1	32x4	32x4	Opt	Brush.	Jacox	Stewart	Plain 2	Ball	Roll	Roll	Monroe M-6
Jacobson	Unit X	3	Sp.B.	Tor-T	Jacobson	Semi-F	4.75-1	32x3½	32x3½	Wood	S-E	Ditwiler	Stewart	Plain 3	R&P	Roll	Roll	Moon 6-36
Grant-Lees	Unit M	3	Sp.B.	Springs	Hess	Float	4.75-1	34x4	34x4	Wood	S-E	Gemmer	Van Sicklen	Plain 3	Ball	B&R	Ball	Moon 6-45
Warner	Unit M	3	Sp.B.	Springs	Timken	Semi-F	4.45-1	35x4½	35x4½	Wood	S-E	Gemmer	Van Sicklen	Plain 3	Ball	Roll	Roll	Moon 6-66
Grant-Lees	Unit-M	3	Bevel	Tor-A	Peru	Float	4.25-1	30x3½	30x3½	Wood	Cant.	Ditwiler	Stewart	Plain 3	Ball	Roll	Ball	Moore 30-E
Grant-Lees	Unit-M	3	Bevel	Tor-T	Peru	Float	4.25-1	30x3½	30x3½	Wood	Cant.	Gemmer	Stewart	Plain 3	Ball	B&R	Ball	Moore 30
Covert	Unit M	3	Sp.B.	Springs	Timken	Float	4.45-1 / 4.08-1	34x4½	34x4½	Wood	¾ Ell	Gemmer	Stewart	Plain 3	Ball	Roll	Roll	Murray
Own	Unit M	3	Sp.B.	Springs	Own	Semi-F	4.50-1	34x4	34x4	Wood	S-E	Gemmer	Stewart	Plain 3	Roll	Roll	Roll	Nash 681-683
Own	Unit M	3	Sp.B.	Springs	Own	Semi-F	4.50-1	34x4	34x4	Wood	¾ Ell	Gemmer	Van Sicklen	Plain 3	Roll	Roll	Roll	Nash 671
Own	Unit M	3	Sp.B.	Springs	Own	Semi-F	4.50-1	34x4	34x4	Wood	S-E	Gemmer	Stewart	Plain 3	Roll	Roll	Roll	Nash 684
Warner	Unit M	3	Sp.B.	Tor-A	Columbia	Float	4.58-1	34x4½	34x4½	Wood†	Cant.	Warner	Warner	Plain 3	Ball	Roll	Ball	National
Warner	Unit M	3	Sp.B.	Tor-A	Columbia	Float	4.58-1	34x4½	34x4½	Wood†	Cant.	Warner	Warner	Plain 3	Ball	Roll	Roll	National
Own	Unit X	3	Sp.B.	Rad-Rd	Own	Float	4.25-1	32x4	32x4	Wood	Trans.	Own	Stewart	Plain 2	B&R	B&R	Ball	Nelson
T.W.Warner	Unit M	3	Bevel	Springs	West-M	Float	4.50-1	32x4	32x4	Wood	S-E	Jacox	Stewart	Plain 3	B&P	B&R	Ball	Oakland 34B
Northway	Unit M	3	Sp.B.	Springs	West-M	Float	4.58-1	32x4	32x4	Wood	S-E	Jacox	Stewart	Plain 3	BR&P	B&R	Roll	Oldsmobile 37
Own	Unit M	3	Sp.B.	Springs	West-M	Float	4.92-1	34x4	34x4	Wood	¾ Ell	Jacox	Stewart	Plain 2	BR&P	B&R	Roll	Oldsmobile 45A
Own	Unit M	3	Sp.B.	Rad-Rd	Own	¾ Float	4.75-1	32x3½	32x3½	Opt	Trans.	Warner	Stewart	Plain 2	B&P	B&R	Ball	Olympian
Own	Unit X	....	Bevel	Tor-T	Own	¾ Float	4.00-1	32x4	32x4	Wood	Cant.	Own	Stewart	Plain 5	B&R	B&R	Roll	Overland 85
Own	Unit X	....	Bevel	Tor-T	Own	¾ Float	4.00-1	31x4	31x4	Wood	Cant.	Own	Stewart	Plain 2	BR&P	B&R	Roll	Overland 90
Own	Unit X	....	Sp.B.	Tor-T	Own	¾ Float	4.60-1	32x4	32x4	Wood	Cant.	Own	Stewart	Plain 3	B&R	B&R	Roll	Overland 85
Magnetic	Unit M	6	Sp.B.	Springs	American	Float	4.00-1	35x5	35x5	Opt	S-E	Own	Stewart	Plain 3	......	Roll	Roll	Owen Magnetic W-42
Own	Unit M	3	Sp.B.	Tor-A	Own	Semi-F	4.36-1	35x5	35x5	Wood	S-E	Own	Waltham	Plain 3	B&R	Ball	Roll	Packard 3-25 & 3-35
Own	Unit M	3	Sp.B.	Tor-T	Salisbury	¾ Float	4.42-1	32x4	32x4	Wood	Cant.	Jacox	Stewart	Plain 3	BR&P	B&R	Roll	Paige 6-39
Own	Unit M	3	Sp.B.	Tor-T	Salisbury	¾ Float	4.36-1	35x4½	35x4½	Wood	Cant.	Jacox	Stewart	Plain 3	BR&P	B&R	Ball	Paige 6-55
Warner	Unit M	3	Sp.B.	Springs	Timken	Semi-F	4.45-1	33x4½	33x4½	Wood	S-E	Warner	Stewart	Plain 3	Ball	Roll	Roll	Pan American G-5
Warner	Unit M	3	Sp.B.	Springs	Timken	Semi-F	3.70-1	33x4½	34x5	Wood	S-E	Warner	Stewart	Plain 3	Ball	Roll	Roll	Pan American J-7
Detroit	Unit M	3	Sp.B.	Springs	Hess	Float	4.50-1	32x4	32x4	Wood	¾ Ell	Jacox	Stewart	Plain	Plain	Roll	Ball	Patersen 6-45
Brown-Lipe	Unit M	3	Sp.B.	Springs	Timken	Semi-F	4.90-1	35x4½	35x4½	Wood	Plat	Gemmer	Warner	Plain 3	B&R	Roll	Roll	Peerless 56
Grant-Lees	Unit M	3	Bevel	Springs	W-Weiss	Semi-F	4.00-1	32x3½	32x3½	Wood	S-E	Gemmer	Van Sicklen	Plain 3	Roll	Roll	Ball	Pennsy
Detroit	Unit M	3	Sp.B.	Springs	Columbia	Float	4.58-1	33x4	33x4	Wood	¾ Ell	Gemmer	Van Sicklen	Plain 3	Ball	Roll	Ball	Pennsy
....	Amid	4	Sp.B.	Rad-Rd	....	Float	4.00-1	32x4½	32x4½	Opt	Cant.	....	Warner	Plain 3	Ball	Roll	B&R	Phianna M
Own	Amid	4	Sp.B.	Tor-T	Own	Semi-F	3.78-1	34x4½	34x4½	Wood	¾ Ell	Own	Warner	Plain 7	Ball	B&R	Roll	Pierce-Arrow C-4
Own	Amid	4	Sp.B.	Tor-T	Own	Semi-F	3.53-1	35x5	35x5	Wood	¾ Ell	Own	Warner	Plain 7	Ball	B&R	Roll	Pierce-Arrow B-4
Own	Amid	4	Sp.B.	Tor-T	Own	Semi-F	2.88-1	36x5½	36x5½	Wood	¾ Ell	Own	Warner	Plain 7	Ball	B&R	Roll	Pierce-Arrow A-4
Muncie	Unit M	3	Sp.B.	Tor-T	Hess	¾ Float	4.25-1	32x4	32x4	Wood	Cant.	C. A. S.	Stewart	Plain 3	B&R	B&R	Roll	Pilot 6-45
Detroit	Unit M	3	Sp.B.	Springs	Timken	Semi-F	4.45-1	32x4½	32x4½	Wood	S-E	Warner	Warner	Plain 3	B&P	Roll	Roll	Premier 6-C
Grant-Lees	Unit M	3	Sp.B.	Springs	Own	Float	4.25-1	32x3½	32x3½	Wood	¾ Ell	....	Van Sicklen	Plain 3	B&R	B&R	Ball	Princess 36-F
Grant-Lees	Unit M	3	Bevel	Tor-T	Peru	Float	4.25-1	30x3½	30x3½	Wood	Cant.	C. A. S.	Stewart	Plain 3	Ball	B&R	Ball	Regal J
Own	Amid	3	Sp.B.	Tor-A	Own	Semi-F	4.30-1	34x4	34x4	Wood	¾ Ell	Own	Stewart	Plain 3	Roll	Roll	Roll	Reo R
Own	Amid	3	Sp.B.	Tor-A	Own	Float	4.30-1	34x4½	34x4½	Wood	Cant.	Own	Stewart	Plain 3	Roll	Roll	Roll	Reo M
Grant-Lees	Unit M	3	Sp.B.	Tor-T	Hess	¾ Float	3.77-1	32x4½	32x4½	Wire	S-E	Jacox	Stewart	Plain 3	B&R	Ball	Ball	Roamer D-4-75
Grant-Lees	Unit M	3	Sp.B.	Tor-T	Hess	¾ Float	3.77-1	32x4	32x4	Wire	S-E	Jacox	Stewart	Plain 3	B&R	Ball	Ball	Roamer C-6-54
Fuller	Unit M	3	Sp.B.	Tor-T	Timken	Float	3.50-1	34x4½	34x4½	Wire	S-E	Jacox	Warner	Plain 3	B&R	Ball	Roll	Roamer D-6-90
Own	Unit X	3	Sp.B.	Tor-T	Timken	Semi-F	5.00-1	30x3	30x3	Wood	½ Ell	Own	Standard	Plain 2	BR&P	B&R	Ball	Saxon B-5
Own	Unit X	3	Sp.B.	Tor-T	Timken	Semi-F	4.75-1	32x3½	32x3½	Opt	Cant.	Warner	Stewart	Plain 3	BR&P	Roll	Roll	Saxon S-4
Mechanics	Unit M	3	Sp.B.	Springs	Hess	¾ Float	4.75-1	32x4	32x4	Wood	S-E	Warner	Stewart	Plain 3	B&P	B&R	Ball	Sayers
T.W.Warner	Unit M	3	Bevel	Rad-Rd	W-Weiss	¾ Float	3.69-1 / 4.07-1	30x3½	30x3½	Wire	Cant.	Jacox	Stewart	Plain 3	B&P	......	Ball	Scripps-Booth G

Splash-Pres—*Splash Pressure*
Spur—*Spur Gears*
T—*T-Head*
Ther—*Thermo-Syphon*
Tor-A—*Torsion Arm*
Tor-R—*Torsion Rod*
Tor-T—*Torsion Tube*
Tr S-E—*Tranverse Semi-Elliptic*
Unit-M—*Unit with Motor*
Unit-T—*Unit with Torque Tube*
Unit-X—*Unit with Axle*
Vib-Dup—*Vibrating Duplex*
†—*Wire Extra*

EQUIPMENT

Allis-Ch—*Allis-Chalmers*
At Kent—*Atwater Kent*
A. W. T.—*American Watch Tool Co.*
Continent—*Continental*
Cut-Hammer—*Cutler-Hammer*
G.B.&S.—*Golden, Belknap & Swartz*
G. & D.—*Gray & Davis*
Gen. Elec.—*General Electric*
Hersh-Sp—*Herschell-Spillman*
Johns-Man—*Johns-Manville*
Leece-N—*Leece-Neville*
Longmare—*Longuemare*
Mass-Ph—*Massnick-Phipps*
Mer & Evans—*Merchant & Evans*
Reichbch—*Reichenbach*
Rob-Myers—*Robbins & Myers*
Shkspere—*Shakespeare*
Teet-Hart—*Teetor-Hartley*
U-S-L—*U. S. Light & Heating Corp.*
W-Weiss—*Walker-Weiss*
Ward-L—*Ward Leonard*
West-M—*Weston-Mott*

1918 Passenger Automobiles Listed with

MAKE AND MODEL	Wheel-base	No. of Cylinders	Bore and Stroke, Inches	Piston Displacement, Cubic Inches	Make of Engine	Cylinder Shape	Cam-shaft Drive	Water Circulation	LUBRICATION System	LUBRICATION Type of Pump	CARBURETION Make of Carbureter	CARBURETION Fuel Feed	IGNITION System	IGNITION Make	IGNITION Control	ELECTRIC SYS. Generator Make	ELECTRIC SYS. Voltage	CLUTCH Make	CLUTCH Type
Scripps-Booth H	120	8	2⅝x3¾	162	Ferro	I	Helical	Ther.	Pressure	Gear	Zenith	Vacuum	Single	Remy	Atmtc	Wagner	6	Goodspeed	Disk
Seneca O	108	4	3⅛x4½	138	LeRoi	F	Helical	Ther.	Circ-Spl	....	Schebler	Vacuum	Single	....	Hand	Allis-Ch	6	Borg & Beck	Plate
Shad-Wyck A&B	128	6	3½x5¼	303	Continent	L	Helical	Cent.	Splash-Pres	Piston	Rayf.-Miller	Vacuum	Single	Eisemann	Hand	Westinghouse	6	Warner	Disk
Simplex V	143½	6	4⅜x6¼	564	Own	L	Chain	Cent.	Splash-Pres	Gear	Newcomb	Pressure	Dual	Eisemann	Hand	Bosch	12	Own	Disk
Singer	139	6	4 x5½	414	Hersh-Sp	T	Helical	Cent.	Pressure	Gear	Rayfield	Vacuum	Single	Bosch	Hand	Westinghouse	6	Muncie	Disk
Standard G	127	8	3¼x5	332	Hersh-Sp	L	Helical	Cent.	Pressure	Gear	Zenith	Vacuum	Single	Splitdorf	Hand	Westinghouse	6	Borg & Beck	Plate
States C	110	6	3 x4½	191	Own	L	Helical	Ther.	Splash-Pres	Piston	Shkspere	Vacuum	VibDup	Connecticut	Hand	Dyneto	6	Borg & Beck	Plate
Stearns SKL	119	4	3¾x5⅝	248	Own	K	Chain	Cent.	Splash-Pres	Gear	Schebler	Vacuum	Single	Remy	Hand	Westinghouse	12	Own	Disk
Stearns SK	125	8	3¼x5	332	Own	K	Chain	Ther.	Splash-Pres	Gear	Rayfield	Vacuum	Single	Remy	Hand	Westinghouse	12	Own	Disk
Stephens	118	6	3¼x4½	224	Own	I	Helical	Ther.	Pressure	Gear	Stromberg	Vacuum	Single	Delco	Hand	Delco	6	Borg & Beck	Plate
Studebaker SH	112	4	3½x5	192	Own	L	Helical	Cent.	Circ-Spl	Gear	....	Vacuum	Single	Remy	Hand	Wagner	6	Own	Cone
Studebaker EH	119	6	3½x5	289	Own	L	Helical	Cent.	Circ-Spl	Gear	....	Vacuum	Single	Remy	Hand	Wagner	6	Own	Cone
Studebaker EG	126	6	3⅞x5	354	Own	L	Helical	Cent.	Circ-Spl	Gear	....	Vacuum	Single	Remy	Hand	Wagner	6	Own	Cone
Stutz S	120	4	4⅜x6	361	Own	T	Helical	Cent.	Pressure	Gear	Stromberg	Pressure	Double	Remy	Hand	Remy	6	Own	Cone
Templar 445	118	4	3⅜x5½	197	Own	I	Chain	Cent.	Pressure	Gear	Zenith	Vacuum	Single	Remy	S-A	Remy	6	Borg & Beck	Plate
Tulsa D	117½	4	3½x5	192	Lycoming	L	Helical	Ther.	Circ-Spl	Piston	Rayfield	Vacuum	Single	Delco	Hand	Dyneto	6	Borg & Beck	Plate
Velie 38	115	6	3¼x4½	224	Continent	L	Helical	Cent.	Splash-Pres	Piston	Rayfield	Vacuum	Single	Remy	S-A	Remy	6	Borg & Beck	Plate
Velie 39	124	6	3½x5¼	303	Continent	L	Helical	Cent.	Splash-Pres	Piston	Rayfield	Vacuum	Single	Remy	S-A	Remy	6	Borg & Beck	Plate
Westcott	125	6	3½x5¼	303	Continent	L	Helical	Cent.	Splash-Pres	Piston	Rayfield	Vacuum	Single	Delco	S-A	Delco	6	Brown-Lipe	Disk
White	{124½ {137½	4	4¼x5¾	326	Own	T	Helical	Cent.	Pressure	Gear	Own	Vacuum	Single	....	Hand	Leece-N	12	Own	Disk
Willys 89	120	6	3½x5¼	303	Continent	L	Helical	Cent.	Splash-Pres	Piston	Tillotson	Vacuum	Single	Connecticut	Hand	Auto-Lite	6	Own	Cone
Willys-Knight 88	121	4	4⅛x4½	240	Own	K	Chain	Ther.	Splash-Pres	Piston	Tillotson	Vacuum	Single	....	Hand	Auto-Lite	6	Auto-Lite	Cone
Willys-Knight 88	125	8	3⅜x4	286	Own	K	Chain	Ther.	Splash-Pres	Piston	Zenith	Vacuum	Single	Remy	H&A	Auto-Lite	6	Auto-Lite	Cone
Winton 33	128	6	3¾x5¼	348	Own	L	Chain	Cent.	Pressure	Piston	Rayfield	Vacuum	Single	Bosch	Hand	Bijur	6	....	Disk
Winton 48	138	6	4½x5½	525	Own	L	Chain	Cent.	Pressure	Piston	Rayfield	Vacuum	Single	Bosch	Hand	Bijur	6	....	Disk
Wolverine	115	4	3 31/32x6	298	Dues'nb'rg	H	Helical	Cent.	Circ-Spl	Piston	Miller	Vacuum	Single	Bosch	Hand	Bijur	6	Warner	Disk
Wolverine	125	4	4⅜x6	361	Dues'nb'rg	H	Helical	Cent.	Circ-Spl	Piston	Miller	Vacuum	Single	Bosch	Hand	Bijur	6	Warner	Disk
Woods Gas-Electric	124	4	2¾x4	95	Continent	L	Helical	Ther.	Splash-Pres	Piston	Stromberg	Gravity	Single	At Kent	Atmtc	Own	60	....	....
Yale M	126	8	3 x5	283	Colonial	T	Chain	Ther.	Circ-Spl	Piston	Zenith	Vacuum	Single	Remy	Hand	Bijur	6	Detroit	Disk

ABBREVIATIONS

2-pt—*Two Point*
¾ Ell—*¾ Elliptic*
¾ Float—*¾ Floating*
¾ Plat—*¾ Platform*
Amid—*Amidships*
Atmtc—*Automatic*
B & P—*Ball and Plain*
B & R—*Ball and Roller*
B R & P—*Ball, Roller and Plain*
C & C—*Cup and Cone*
Cant—*Cantilever*
Cent—*Centrifugal*
Circ-Spl—*Circulating Splash*
Dual-D—*Dual Double*
Ell—*Elliptic*
F—*F-Head*
Float—*Floating*
Fric—*Friction*
Gear—*Gear Pump*
H—*Horizontal*
H & A—*Hand and Automatic*
I—*I-Head*
Imp—*Impeller*
K—*Knight type*
L—*L-Head*
Mag—*Magnetic*
Non-Spl—*Non-Circulating Splash*
Opt—*Optional*
Plan—*Planetary*
Plat—*Platform*
Rad-Rd—*Radius Rods*
Rev-C—*Reversed Cone*
Roll—*Roller*
S-A—*Semi-Automatic*
S-E—*Semi-Elliptic*
Semi-F—*Semi-Floating*
Sp.B—*Spiral Bevel*
Sp.G—*Spiral Gear*

1918 Steam-Driven

Name and Model	Wheel-base	Type of Boiler	Boiler Location	Type of Engine	Type of Valve Gear	Type of Valves	No. of Cylinders	Bore and Stroke	LUBRICATION Cylinders	LUBRICATION Engine	Engine Location	Final Drive	Fuel
Doble D	135	Water Tube	Under Hood	Dbl. Acting	Own	....	2	5x4	....	....	Rear Axle	Spur Gear	Kerosene
Stanley	130	Fire Tube	Under Hood	Dbl. Acting	Stephenson	Slide	2	4x5	Plunger Pump	Splash	Rear Axle	Spur Gear	Kerosene

These Tables are for reference and

Their Technical Specifications—Continued

TRANSMISSION								RUNNING GEAR								BEARINGS			
GEARSET			Final Drive	Torque Taken By	Make of Rear Axle	Rear Axle Type	Gear Ratio on Direct	TIRES		Wheels	Rear Spr'gs	Make of Steering Gear	Make of Speed-ometer	Crank-shaft Bearings and Number	Gearset	Rear Axle	Front Wheel	MAKE AND MODEL
Make	Loca-tion	Forward Speeds						Front	Rear									
T.W.Warner	Unit M	3	Sp.B	Rad-Rd	Russel	¾ Float	4.80-1 5.33-1	32x4	32x4	Wire	Cant.	Own	Stewart	Plain 2	B&P		Ball	Scripps-Booth H
Detroit	Unit M	3		Tor-T	Adams	Float	4.50-1	30x3½	30x3½	Wood†	Cant.	Ditwiler	Stewart	Plain	Ball	Ball	Ball	Seneca O
Warner	Unit M	3	Sp.B	Springs	Timken	Semi-F	4.45-1	33x4½	33x4½	Wire	S-E	Gemmer	Van Sicklen	Plain 3	Ball	Roll	Roll	Shad-Wyck A&B
Own	Unit M	4	Sp.B	Springs	Own	Float	3.00-1	Opt.	Opt.	Opt.	S-E	Own	Stewart	Plain 3	Roll	B&R	Roll	Simplex V
Muncie	Unit M	4	Sp.B	Tor-T	Timken	Float	3.70-1	35x5	35x5	Wire	Cant.	Gemmer	Stewart	Plain 3	Ball	Roll	Roll	Singer
Grant-Lees	Unit M	3	Sp.B	Springs	Timken	Semi-F	4.45-1	34x4½	34x4½	Wood	S-E	Gemmer	Stewart	Plain 3	B&R	Roll	Roll	Standard G
Detroit	Unit M	3	Sp.B	Tor-T	Own	Float	4.00-1	30x3½	31x4	Wire	Cant.	Own	Van Sicklen	Plain 3	Ball	B&R	Ball	States C
Own	Unit M	3	Sp.B	Tor-A	Own	Semi-F	4.50-1	34x4	34x4	Wood	Cant.	Own	Stewart	Plain 3	B&R	B&R	Roll	Stearns SKL
Own	Unit M	3	Sp.B	Tor-A	Own	Semi-F	4.75-1	35x4½	35x4½	Wood	Cant.	Own	Stewart	Plain 3			Roll	Stearns SK
Mechanics	Unit M	3	Sp.B	Springs	Hess	Float	4.75-1	32x4	32x4	Wood	S-E	Gemmer	Van Sicklen	Plain 3	Ball	Roll	Roll	Stephens
Own	Amid	3	Sp.B	Springs	Own	Semi-F	4.08-1	32x3½	32x3½	Wood	S-E	Own	Warner	Plain 3	R&P	Roll	Roll	Studebaker SH
Own	Amid	3	Sp.B	Springs	Own	Semi-F	4.00-1	32x4	32x4	Wood	S-E	Own	Warner	Plain 4	R&P	Roll	Roll	Studebaker EH
Own	Amid	3	Sp.B	Springs	Own	Semi-F	3.71-1	33x4½	33x4½	Wood	S-E	Own	Warner	Plain 4	R&P	Roll	Roll	Studebaker EG
Own	Unit X	3	Bevel	Tor-T	Own	¾ Float	3.50-1	32x4½	32x4½	Wire	S-E	Gemmer	Stewart	Plain 3	Ball	B&R	Roll	Stutz S
Detroit	Unit M	3	Sp.B	Springs	American	Semi-F	4.81-1	32x4	32x4	Wood	S-E	Jacox	Stewart	Plain 3	B&P	B&R	Roll	Templar 445
Grant-Lees	Unit M	3	Sp.B	Springs	Salisbury		4.50-1	32x	35x	Opt.	S-E	C. A. S.	Stewart	Plain 2	Ball	B&R	Ball	Tulsa D
Durston	Unit M	3	Sp.B	Springs	Timken	Semi-F	4.75-1	32x4	32x4	Wood	¾ Ell.	Gemmer	Stewart	Plain 3	Ball	Roll	Roll	Velie 38
Warner	Unit M	4	Sp.B	Springs	Timken	Semi-F	4.45-1	33x4½	33x4½	Wood	¾ Ell.	Gemmer	Van Sicklen	Plain 3	Ball	Roll	Roll	Velie 39
Brown-Lipe	Unit M	3	Sp.B	Tor-T	Timken	¾ Float	4.45-1	35x4½	35x4½	Wood	Cant.	Gemmer	Warner	Plain 3	B&R	Roll	Roll	Westcott
Own	Unit M	4	Sp.B	Springs	Own	Semi-F		35x5	35x5	Wood	S-E	Own	Stewart	Plain 3	Ball	Ball	Ball	White
Own	Unit X	3	Sp.B	Tor-T	Own	¾ Float	4.00-1	33x4½	33x4½	Opt.	Cant.	Own	Stewart	Plain 3	B&R	B&R	Roll	Willys 89
Own	Unit X	3	Sp.B	Tor-T	Own	Float	4.30-1	34x4½	34x4½	Wood	Cant.	Own	Warner	Plain 3	BR&P	Roll	Roll	Willys-Knight 88
Own	Unit X	3	Sp.B	Tor-T	Own	Float	4.60-1	34x4½	34x4½	Wood	Cant.	Own	Warner	Plain 2	BR&P	Roll	Roll	Willys-Knight 88
Own	Unit M	4	Sp.B	Tor-R	Own	Float	4.45-1	36x4½	36x4½	Wood	¾ Ell.		Warner	Plain 4	B&R	Roll	Roll	Winton 33
Own	Unit M	4	Sp.B	Tor-R	Own	Float	4.08-1	37x5	37x5	Wood	¾ Ell.		Warner	Plain 4	B&R	Roll	Roll	Winton 48
Warner	Unit M	3	Sp.B	Springs	American	Float	2.94-1	32x4½	32x4½	Wire	S-E	Warner	Warner	Plain 3	Ball	Roll	Roll	Wolverine
Warner	Unit M	3	Sp.B	Springs	American	Float	4.00-1	32x4½	32x4½	Wire	S-E	Warner	Warner	Plain 3	Ball	Roll	Roll	Wolverine
Electric	Unit M		Worm	Tor-A	Own	Semi-F	8.25-1	35x4½	35x4½	Wood	Cant.	Gemmer	Stewart	Plain 3	None.	B&R	Roll	Woods
Detroit	Unit M	3	Sp.B	Springs	Timken	Semi-F	4.50-1	34x4	34x4	Opt.	S-E	Jacox	Stewart	Plain 3	Ball	Roll	Roll	Yale M

Splash-Pres—*Splash Pressure*
Spur—*Spur Gears*
T—*T-Head*
Ther—*Thermo-Syphon*
Tor-A—*Torsion Arm*
Tor-R—*Torsion Rod*
Tor-T—*Torsion Tube*
Tr S-E—*Traverse Semi-Elliptic*
Unit-M—*Unit with Motor*
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G. & D.—*Gray & Davis*
Gen. Elec.—*General Electric*
Hersh-Sp—*Herschell-Spillman*
Johns-Man—*Johns-Manville*
Leece-N—*Leece-Neville*
Longmare—*Longuemare*
Mass-Ph—*Massnick-Phipps*
Mer & Evans—*Merchant & Evans*
Reichbch—*Reichenbach*
Rob-Myers—*Robbins & Myers*
Shkspere—*Shakespeare*
Teet-Hart—*Teetor-Hartley*
U-S-L—*U. S. Light & Heating Corp.*
W-Weiss—*Walker-Weiss*
Ward-L—*Ward Leonard*
West-M—*Weston-Mott*

Passenger Automobiles

Control	Fuel Feed	Type of Burner	Feed Water Control	Rear Axle Ratio	Car Drives Through	Torque Taken By	BEARINGS		Wheels		Speed-ometer	Rear Springs	Name and Model
							Rear Axle	Front Wheel					
Automatic	Pressure				Radius Rods		American		35x5	35x5		Semi-Elliptic	Doble D
Automatic	Pressure	Vaporizing	Automatic	1.50-1	Radius Rods	Engine Frame	Timken	Timken	34x4	35x4½	Stewart	Elliptic	Stanley

Constant Consultation—Save them

More Casting—Less Forging

High Cost of Dies and Materials Having Influence on Relative Standing of Forgings, Malleable Iron and Steel Castings

By J. Edward Schipper

THE marked trend toward the more extended use of forgings for brackets, axle parts, etc., has been somewhat checked by the abnormally high prices asked for forgings at the present time. The result of this condition has been a temporary tendency toward an increased use of malleables. It is not probable, however that this tendency is any indication of a permanent condition. Manufacturers have been forced, in some instances, to change from forgings to malleables and in a few instances from malleable to steel castings, simply because of the difficulty in obtaining delivery of certain parts.

Further than this, in view of the present prices of forgings, malleables are being used for some parts where the size is a matter of convenience rather than of structural strength. In a great many trucks which ordinarily would employ forgings, practically all of the frame brackets, spring hangers, motor brackets, etc., are of malleable iron. All parts which are in tension, and particularly those which are under shock, such as shackle links, are made from forgings if possible, and if not, from steel castings.

Forgings the Natural Choice

For the vital parts of all trucks and passenger cars forgings will continue to be used. This refers particularly to such parts as axle centers, steering connections, propeller shaft parts, etc. It is this condition which has put a check for the time being to the big trend toward forgings and stampings, but as soon as the war is over, and conditions are relieved, it is certain that the forgings and stampings will once again come into their own.

The use of forgings, where commercially possible, is a practice which engineers come to whether they go at the matter scientifically or simply by practical results. In the language of one of the prominent tractor engineers, "We use malleable, cast steel and drop forgings for different parts of trucks and tractors. If malleable castings do not stand up, we use cast steel and when cast steel does not give service, we use forgings." This is a rough and ready way of expressing the thought that forgings are not only arrived at by scientific calculation, but also by the results obtained in every-day practice.

It is not an easy matter to classify parts in such a way that by referring to a tabulation you can tell whether it is best practice to use a forging, a casting or a malleable. The question of machining and the question of strength in relation to size, and in some instances the question of weight, always must be considered. Nevertheless, practical experience affords a rough and ready classification, based on the thought that experience indicates clearly the desirability of avoiding the use of cast steel or malleable iron for any parts where the duty is in any way severe.

Many Fear Castings

There are many engineers who fear castings because they are treacherous. It is almost impossible to tell, unless they are machined all over, whether they are sound or not, and steel castings are often the worst offenders in this respect. For such brackets as the rear spring frame brackets and the front spring front end brackets, cast steel or malleable iron is fairly satisfactory from the standpoint of ability to endure in service, although the production losses, due to defective castings, are higher than they should be.

It is true that steel castings are better than they were three years ago, but there is a serious question as to whether the progress in casting has kept pace with progress in design. In other words, the duties required of the parts which have been made of castings in the past have been so increased by the requirement of lightness and other factors necessitating greater unit strength, that steel castings cannot now be used for many of these parts.

Production Losses High

Many engineers feel that there is a strong tendency to get away, as far as possible, from the use of castings for anything except housings or short, stubby brackets, as, where parts can be made of either forgings or stampings, they are much more certain to stand up in service and to be flawless when first made, thus cutting down the production losses. In fact, in estimating the costs on the comparative basis of making certain small parts from castings or forgings, one of the points which must be considered in order to arrive at a fair conclusion is whether or not the production loss, due to defective castings, will not more than overcome a difference in the first cost of the forging. The regrettable part of the losses in castings is that the flaw may not be discovered until several machine operations have been completed, so that losses include not only the material itself, but also the labor and machinery time costs as well.

Rules for Selection

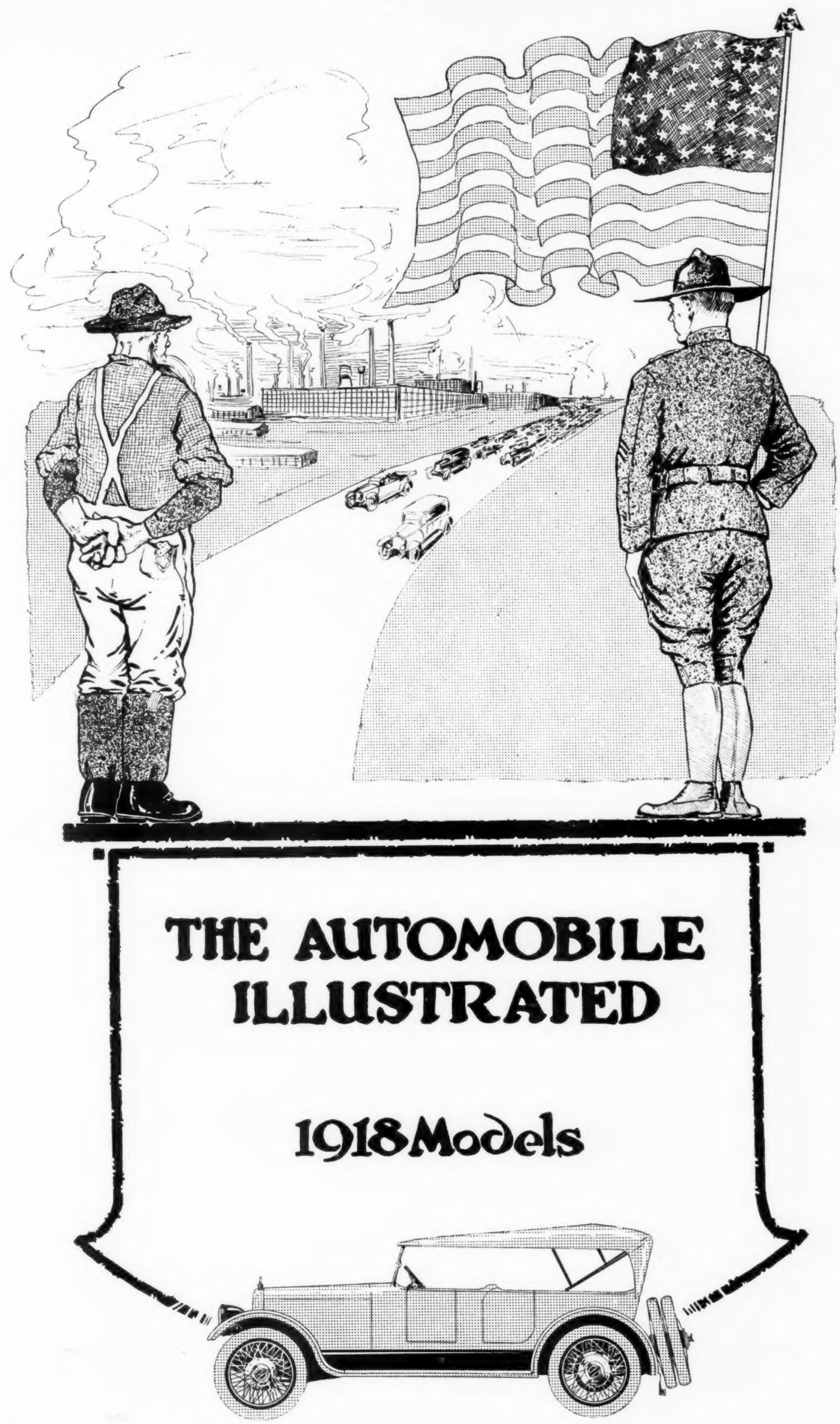
A very prominent engineer in charge of motor truck construction in this country states that the following rules guide him in selecting cast steel, malleable and drop forgings for small brackets, axle parts, etc.:

1—Cast steel is used for more important structural parts that cannot be forged. It must be made fairly heavy to allow for segregation in the castings, blow holes, etc. It should really only be used for complicated pieces.

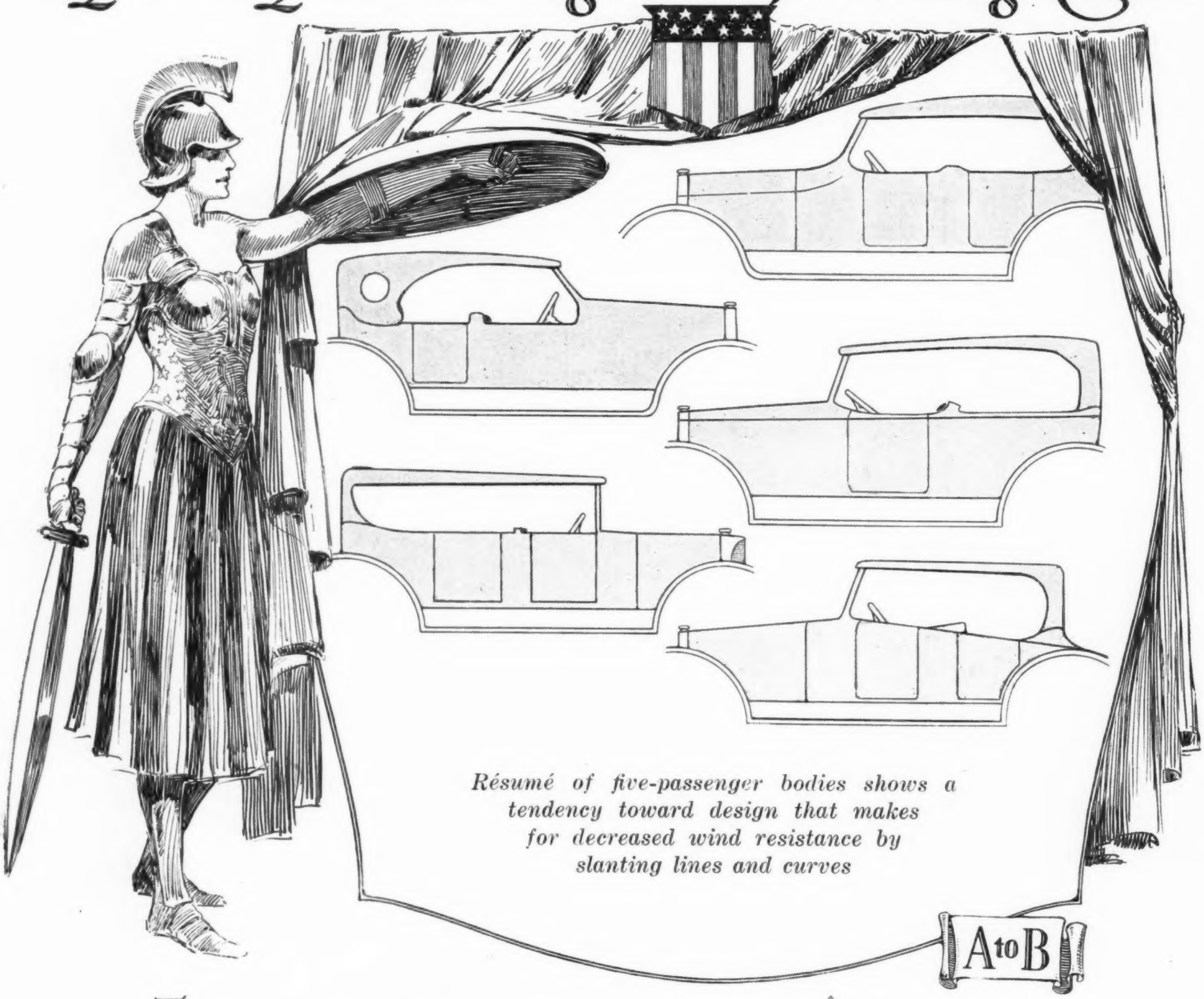
2—Drop forgings should be used where very great strength is required, with lightness.

3—Malleable iron should be used for unimportant structural parts, such as spacers, packing pieces and the like; parts where cast iron itself would probably be strong enough as regards the actual work to be done, but not strong enough to bear transportation and rough handling.

4—In general, it is a very wise rule to use forgings as much as possible, as, after the first cost of dies, they are usually found to be cheaper, much more homogeneous.

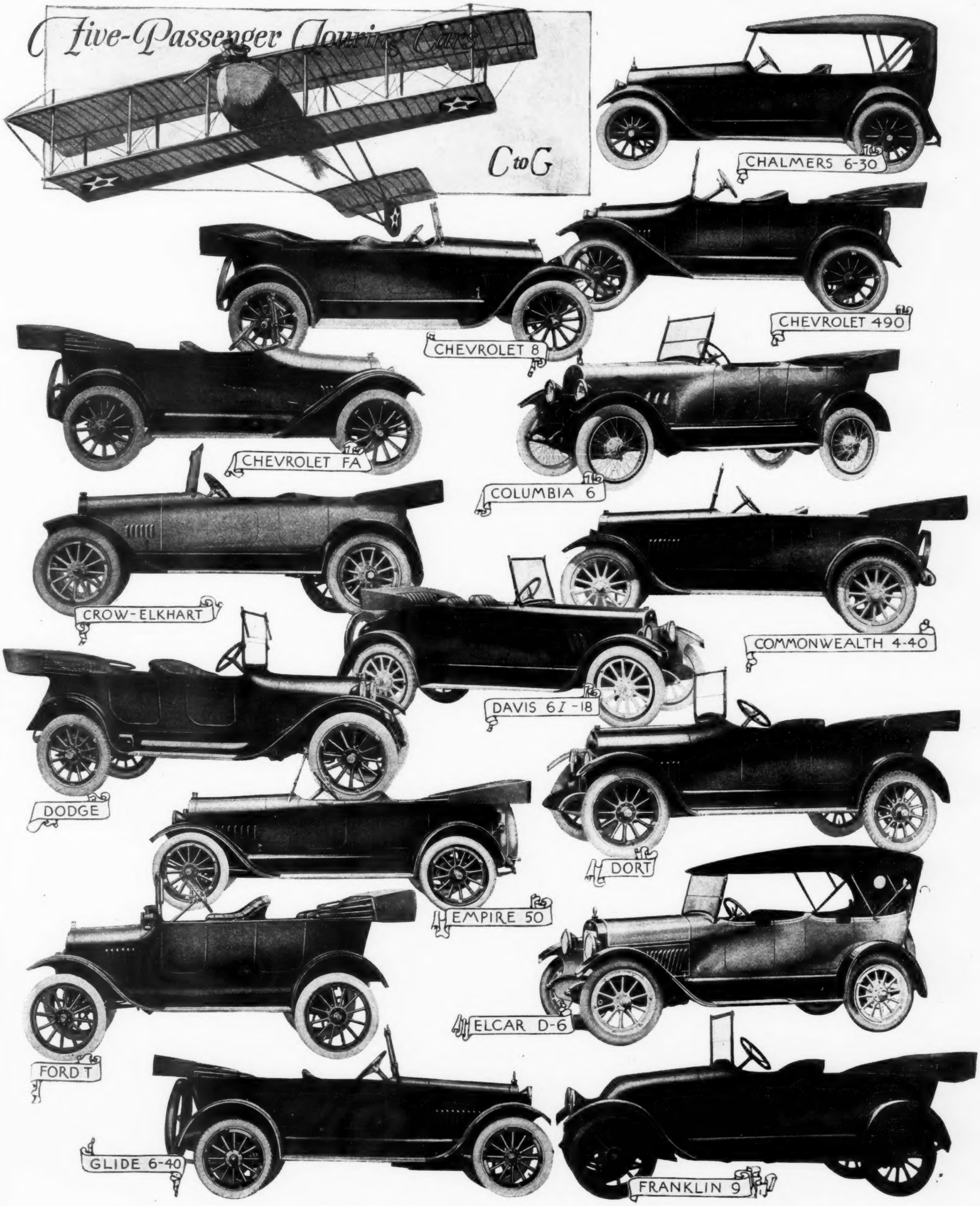

THE AUTOMOBILE
ILLUSTRATED
1918 Models

Five-Passenger Touring Cars



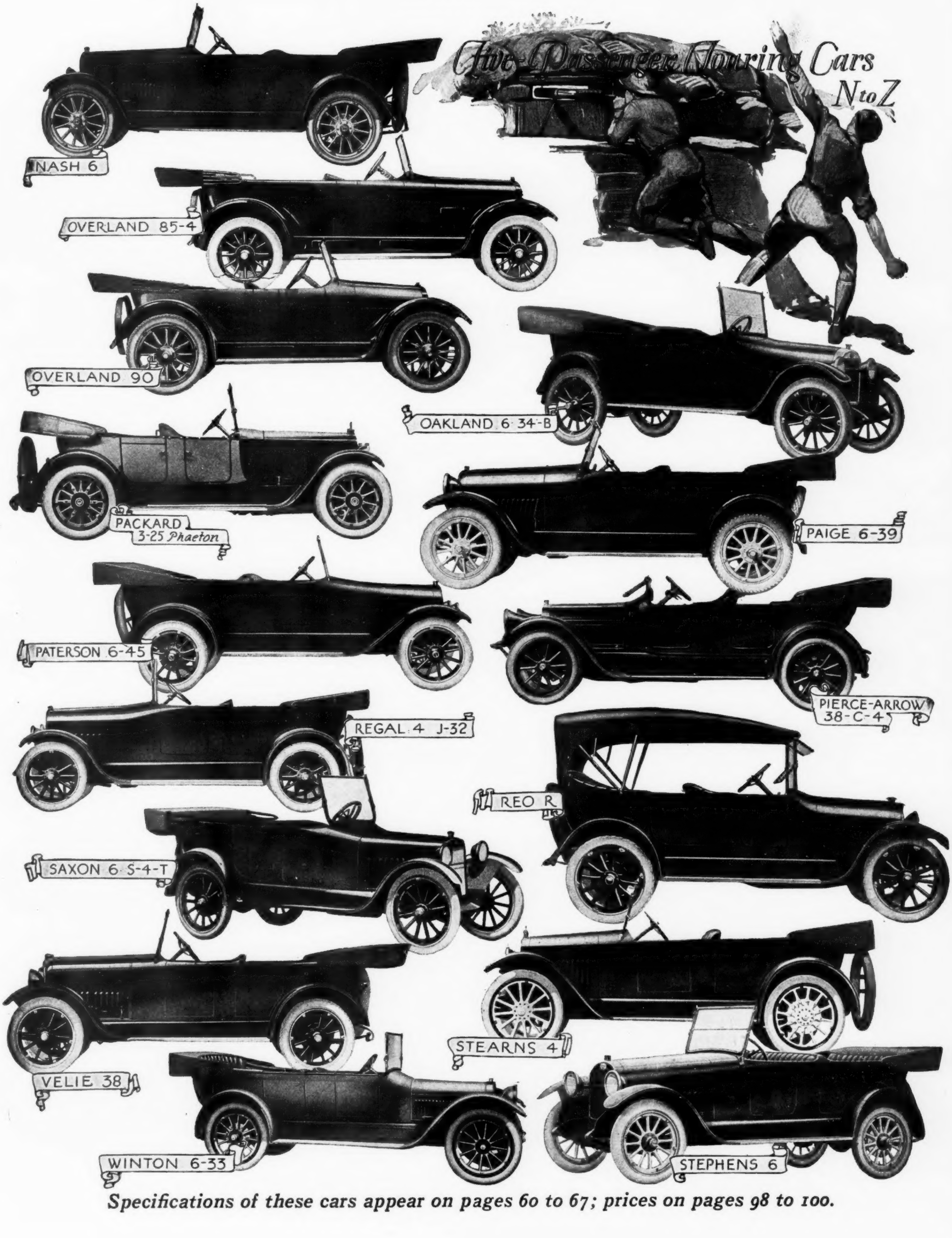
Résumé of five-passenger bodies shows a tendency toward design that makes for decreased wind resistance by slanting lines and curves

Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.

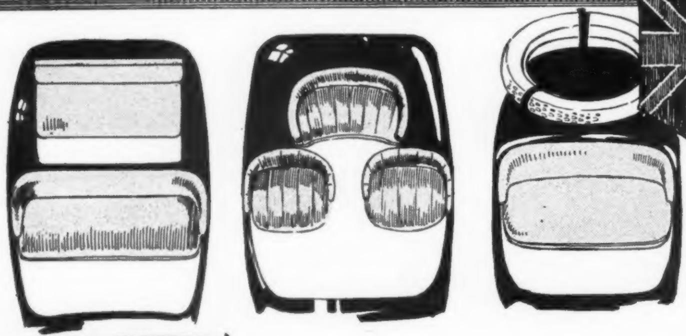


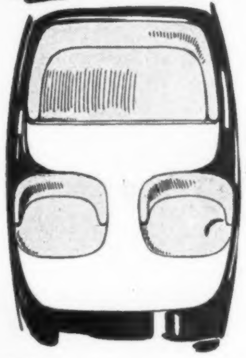
Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.

Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.



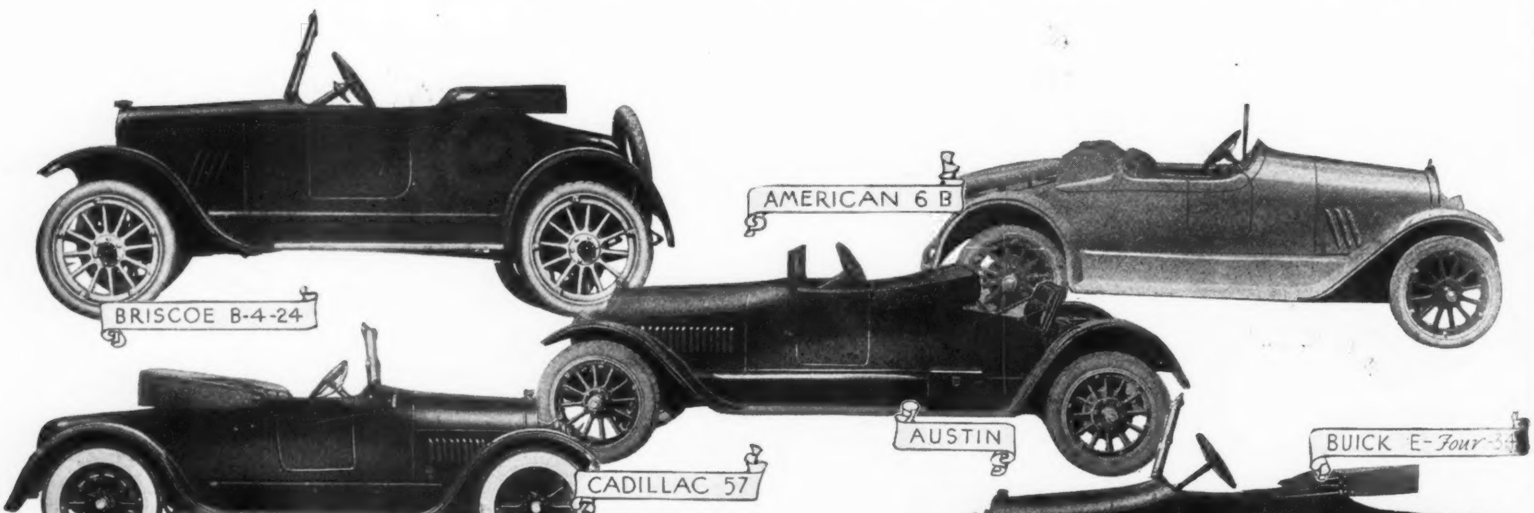
Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.





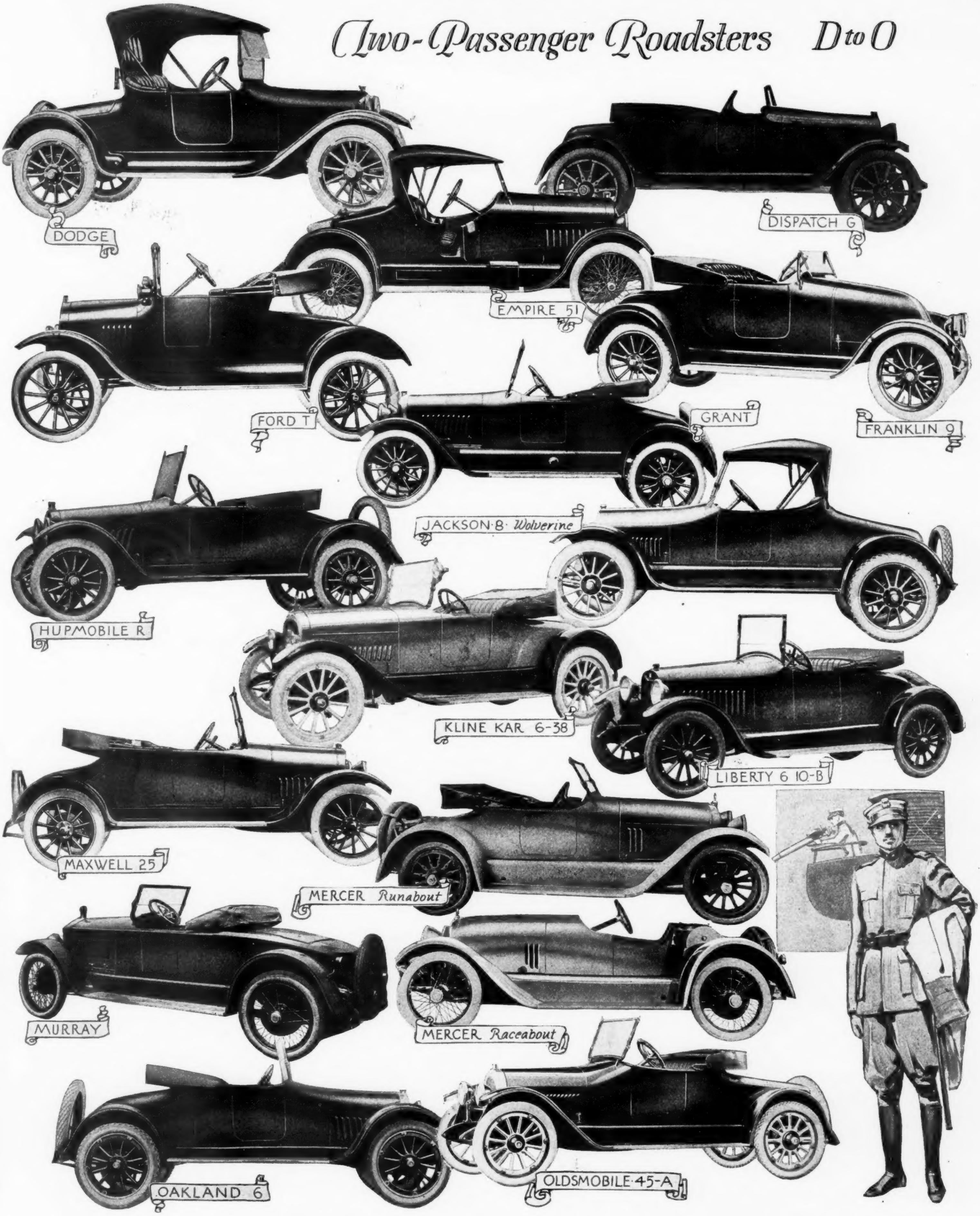
Modern ingenuity has devised various seating arrangements for roadster and runabout. Among them is the four-passenger, the three-passenger and the one-seat car

Two-Passenger Roadsters A to C



Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.

Two-Passenger Roadsters D to O

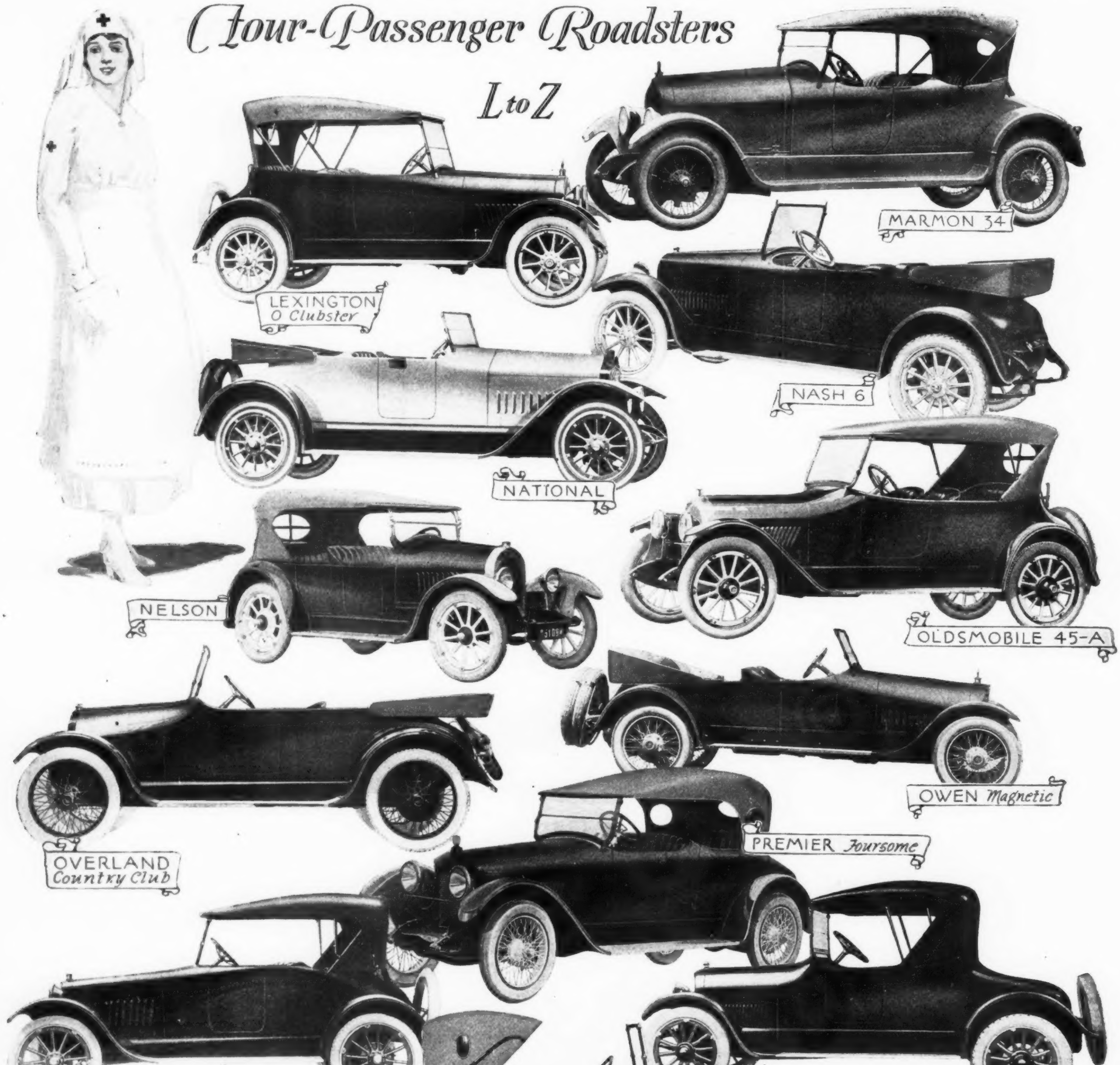


Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.

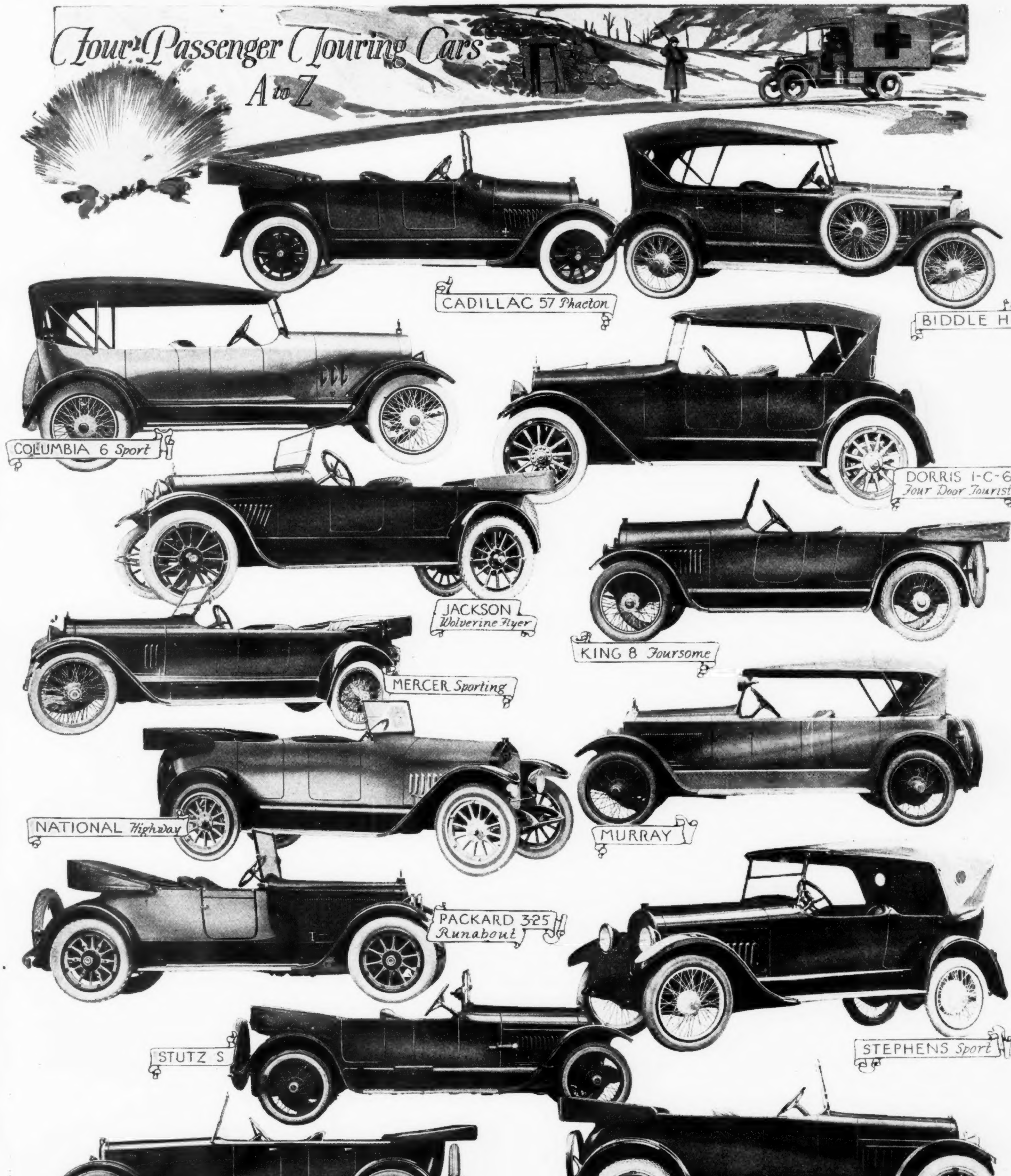
Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.

Four-Passenger Cars
Roadsters A to K

Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.

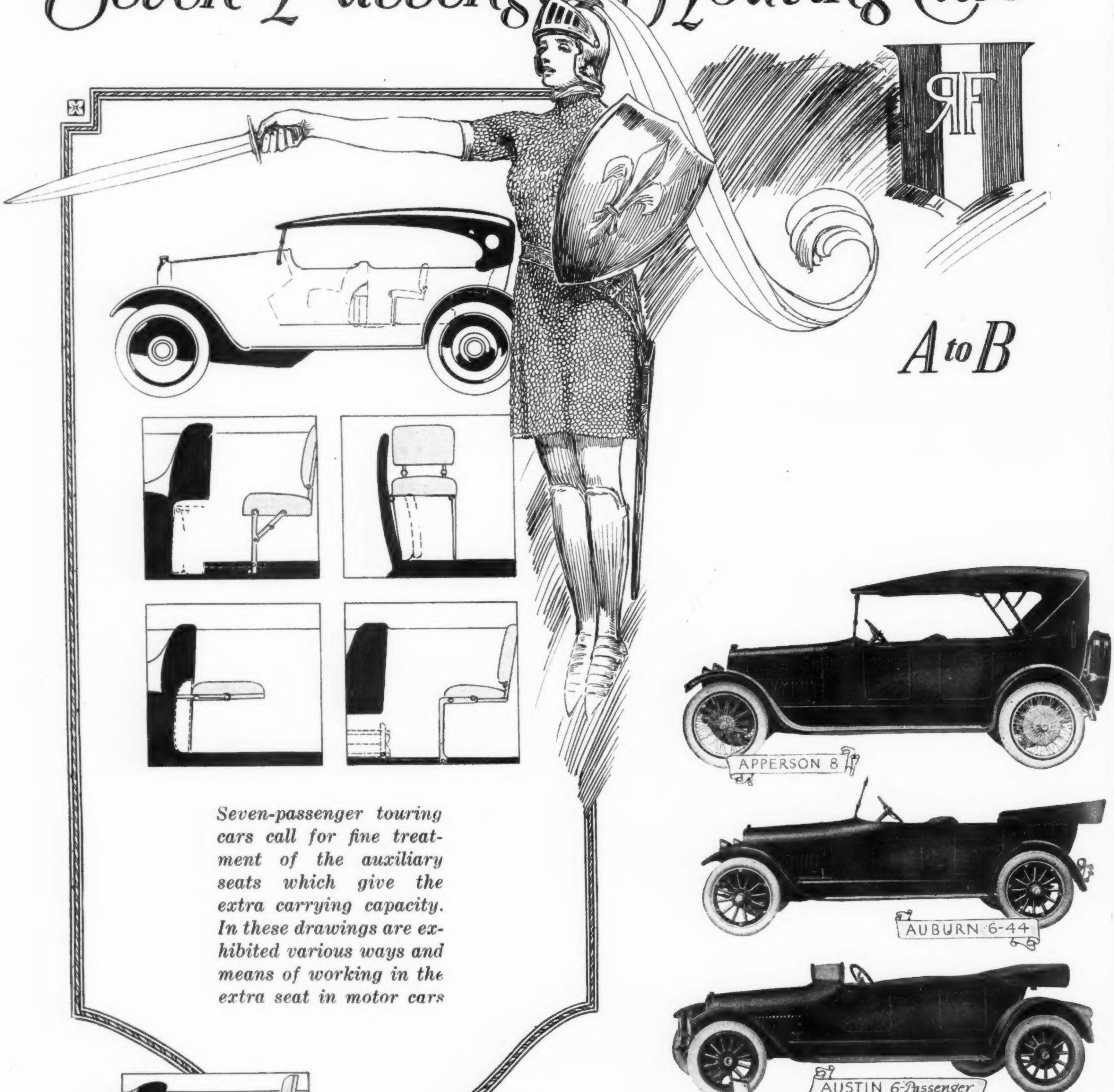


Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.



Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.

Seven-Passenger Touring Cars

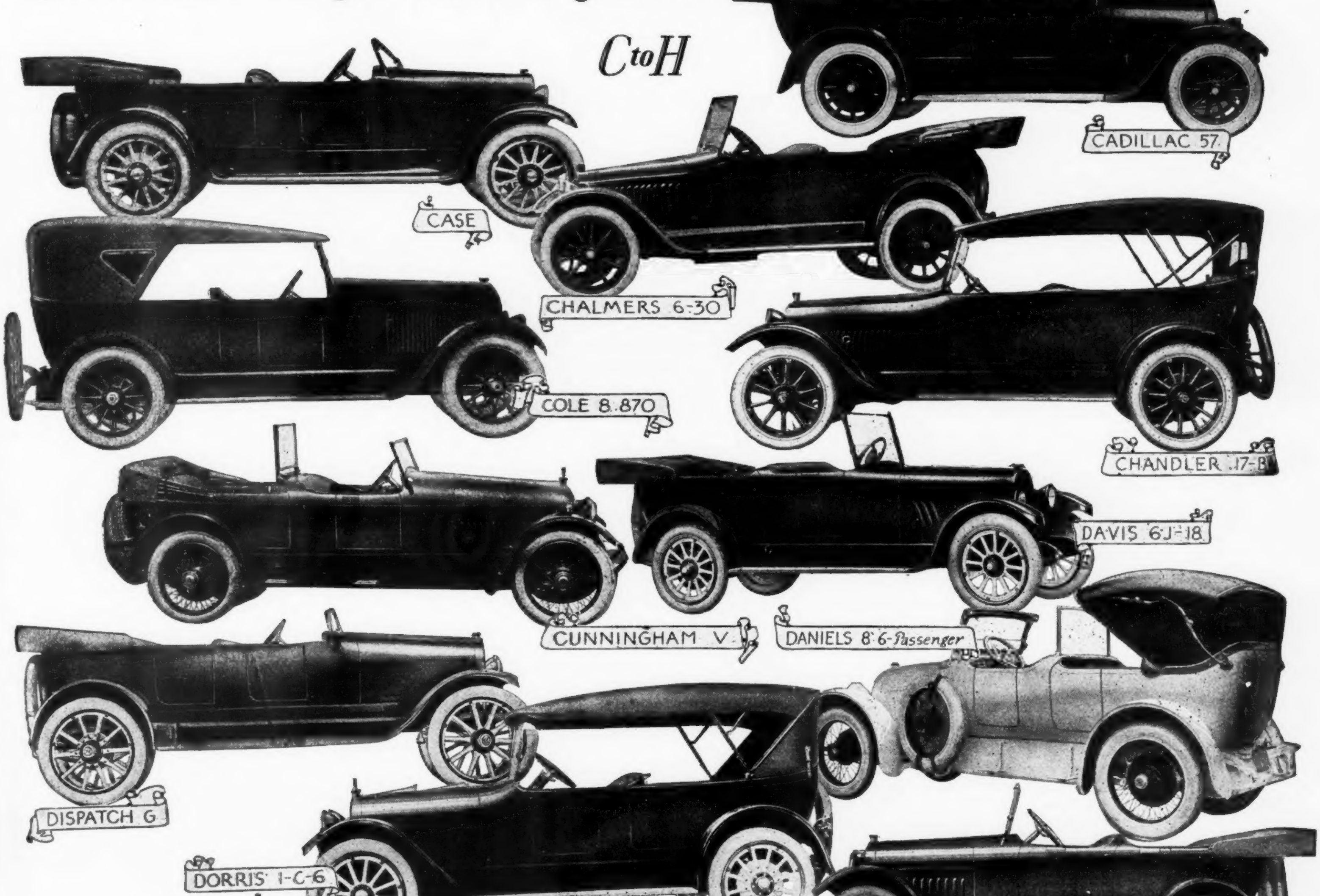


Seven-passenger touring cars call for fine treatment of the auxiliary seats which give the extra carrying capacity. In these drawings are exhibited various ways and means of working in the extra seat in motor cars

Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.

Seven-Passenger Touring Cars

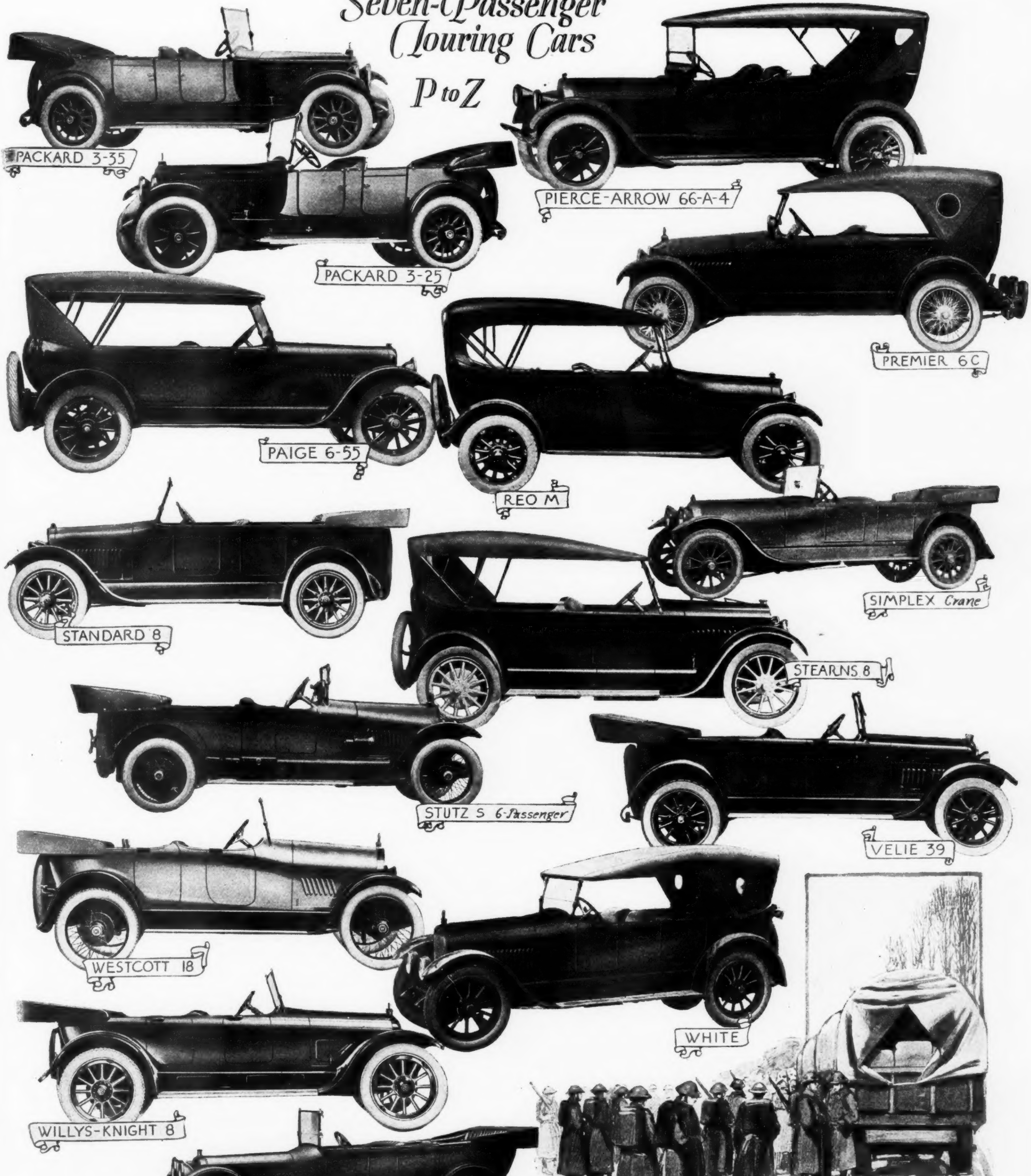
C to H



Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.

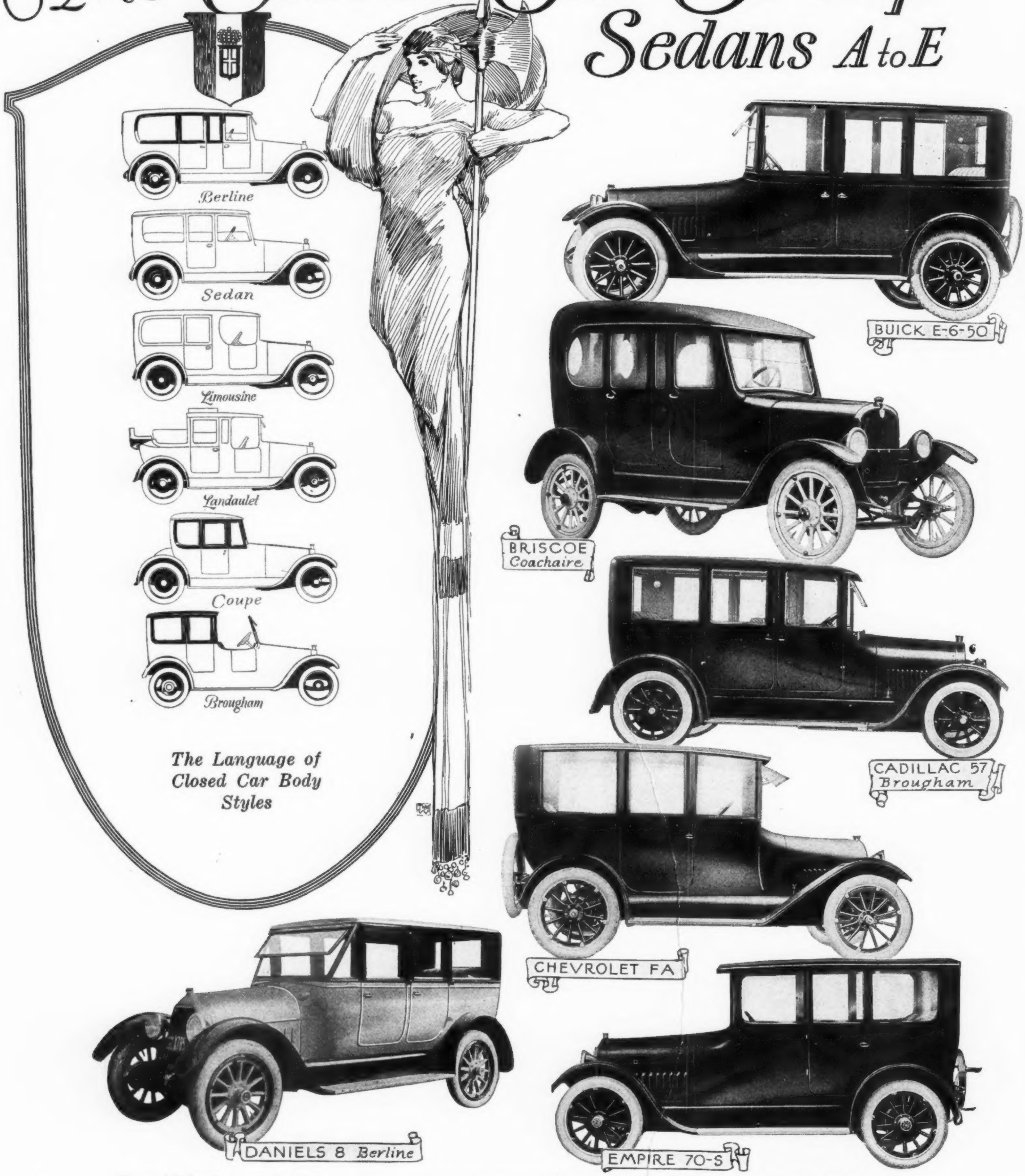
Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.

Seven-Passenger Touring Cars P to Z

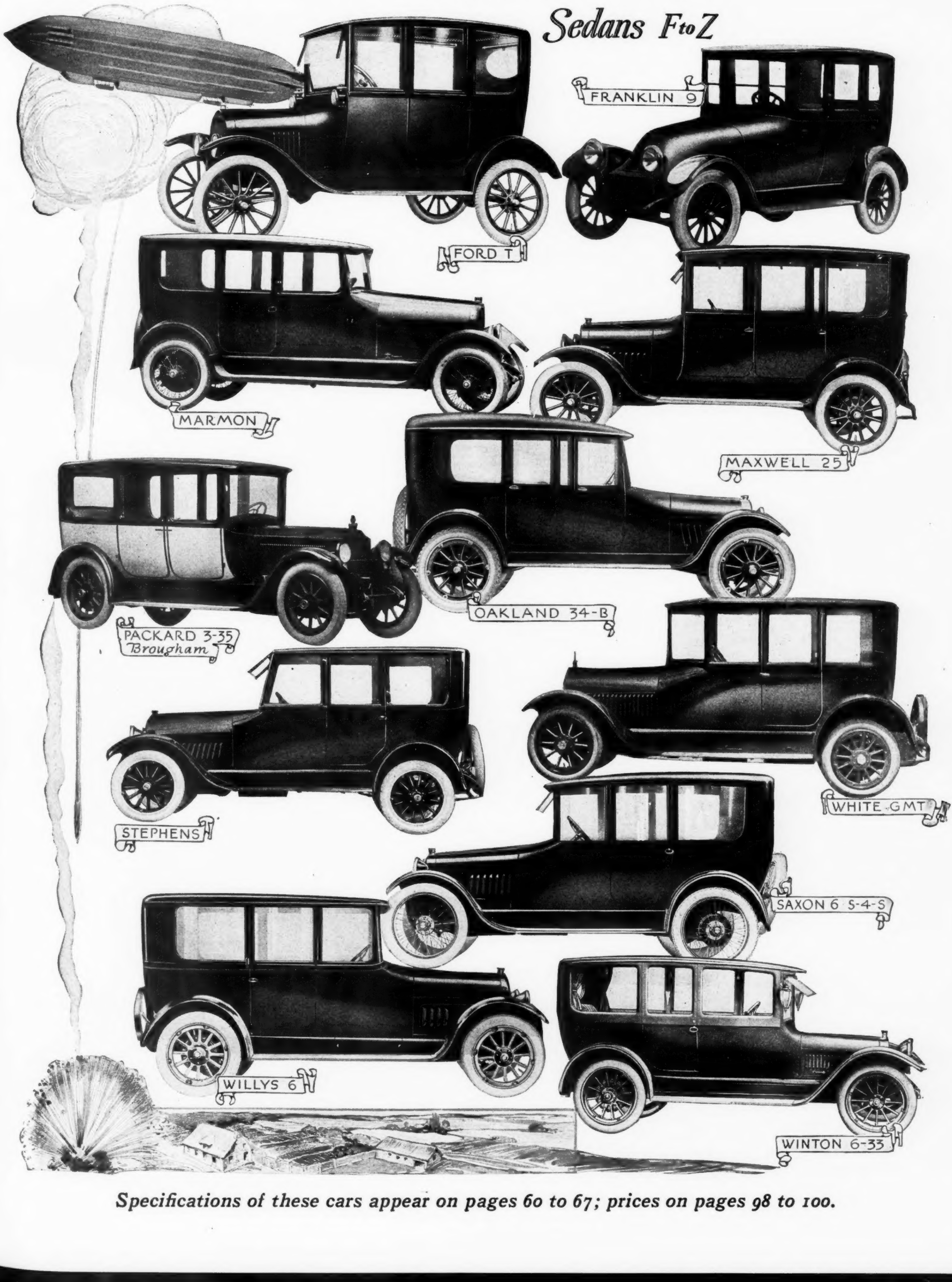


Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.

The Closed Car Group
Sedans A to E

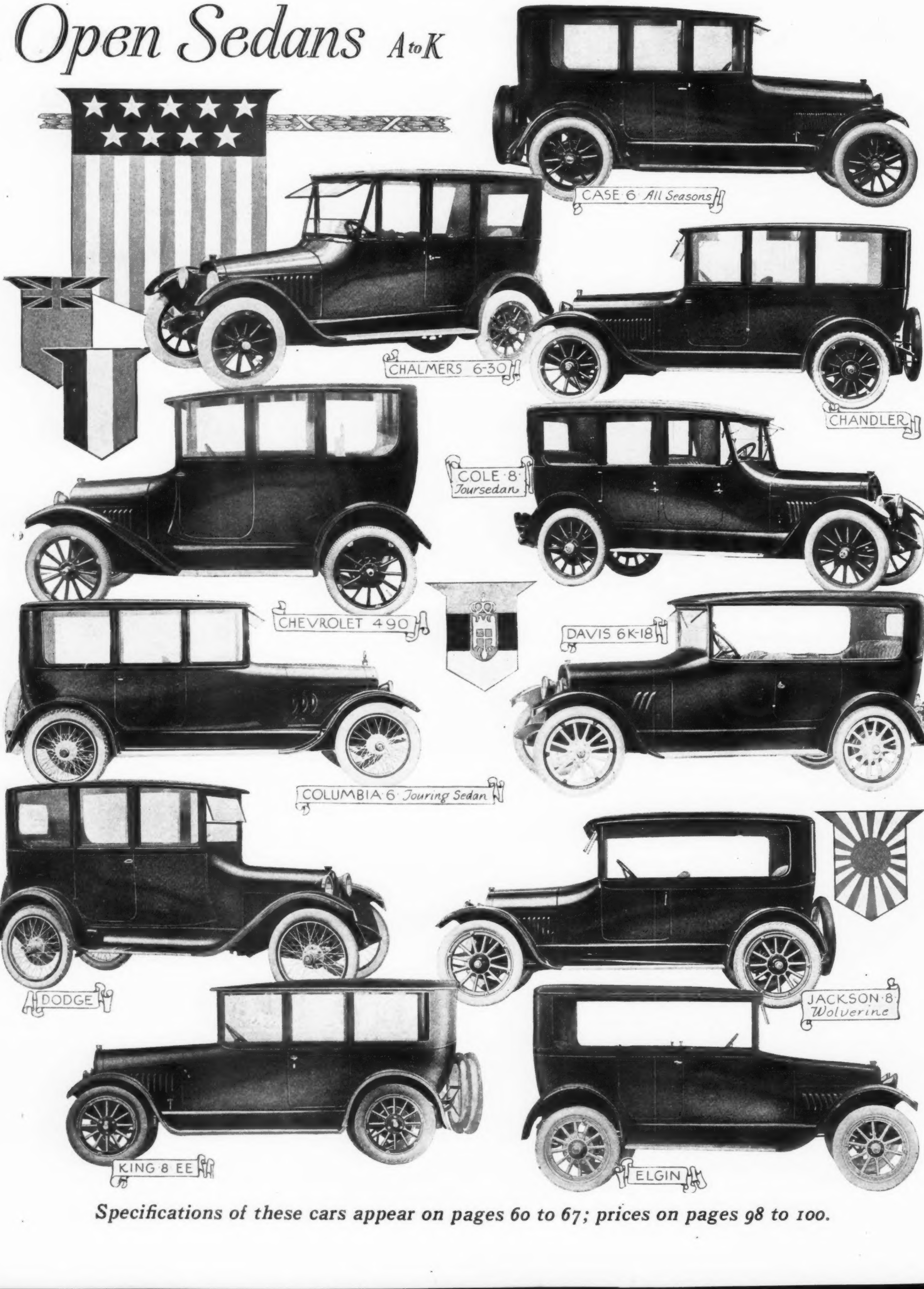


Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.



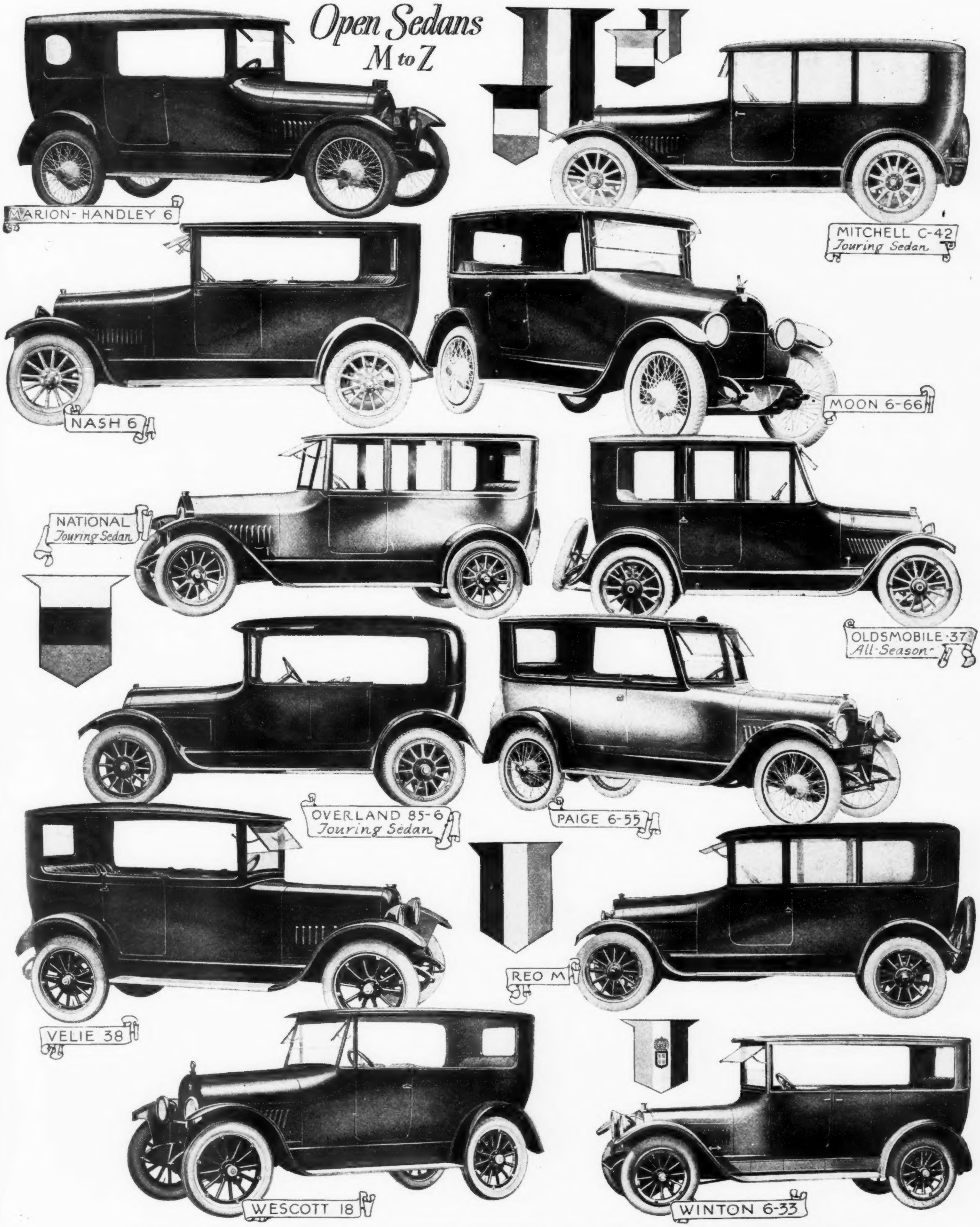
Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.

Open Sedans A to K



Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.

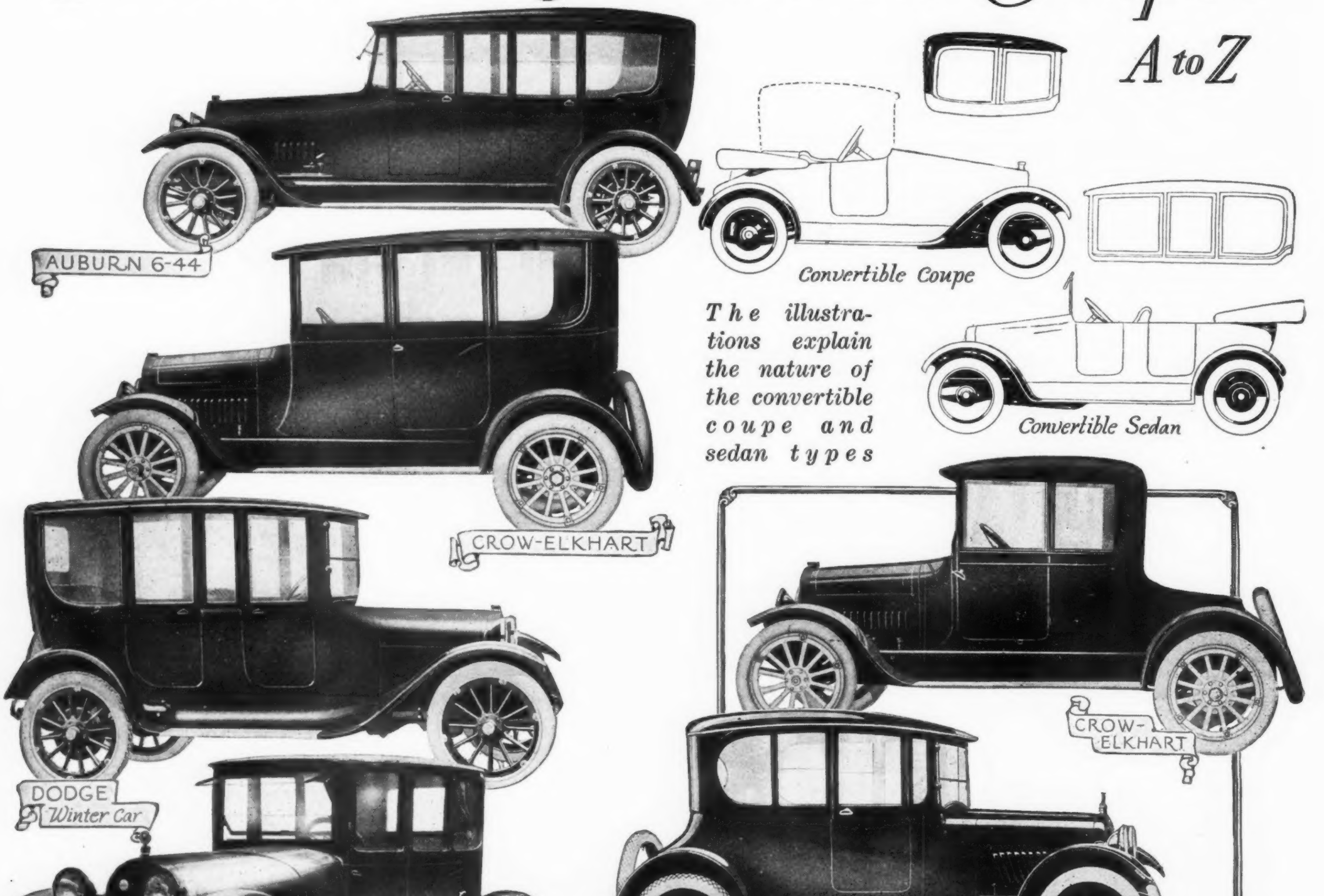
Open Sedans M to Z



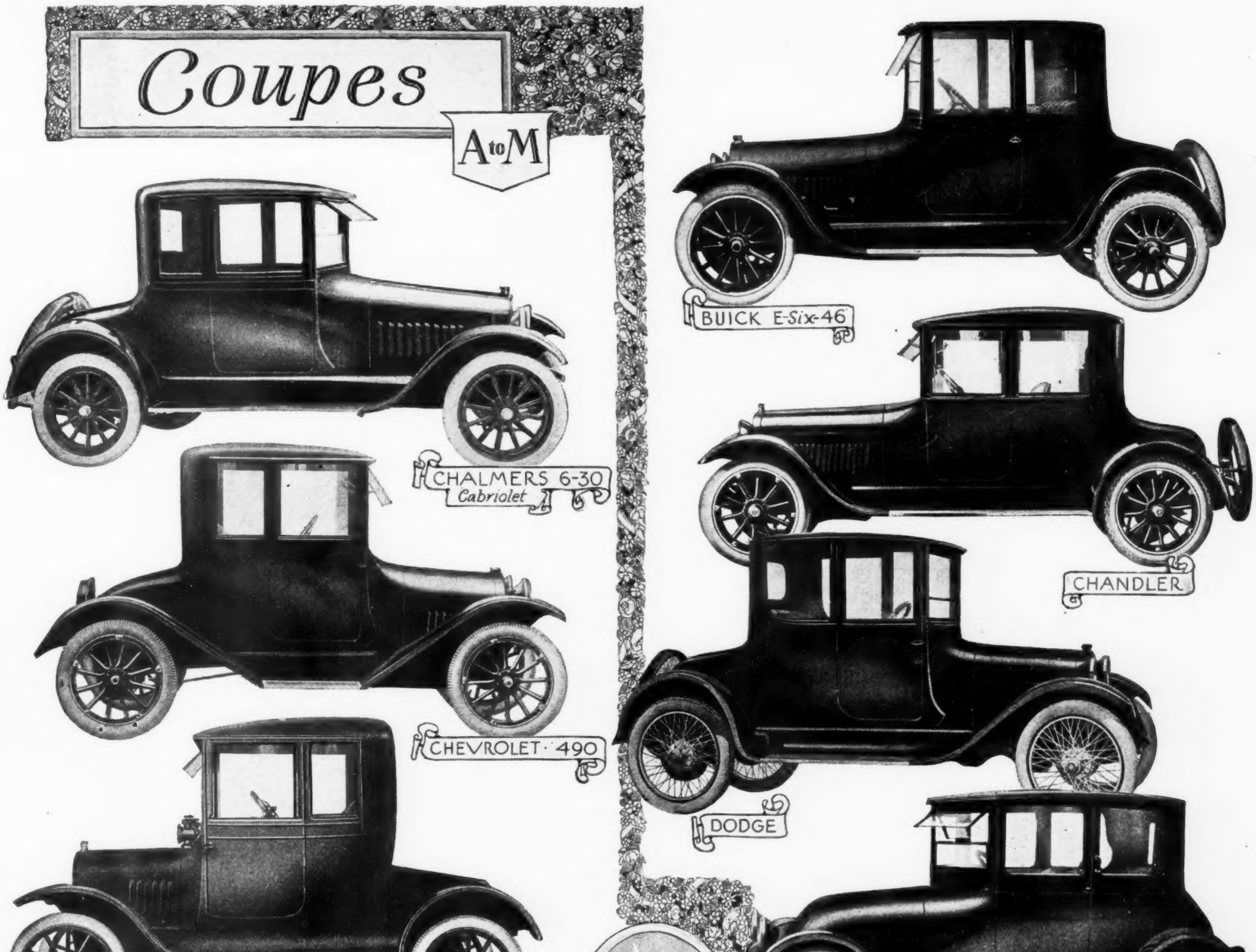
Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.

Convertible Sedans and Coupes A to Z

The illustrations explain the nature of the convertible coupe and sedan types

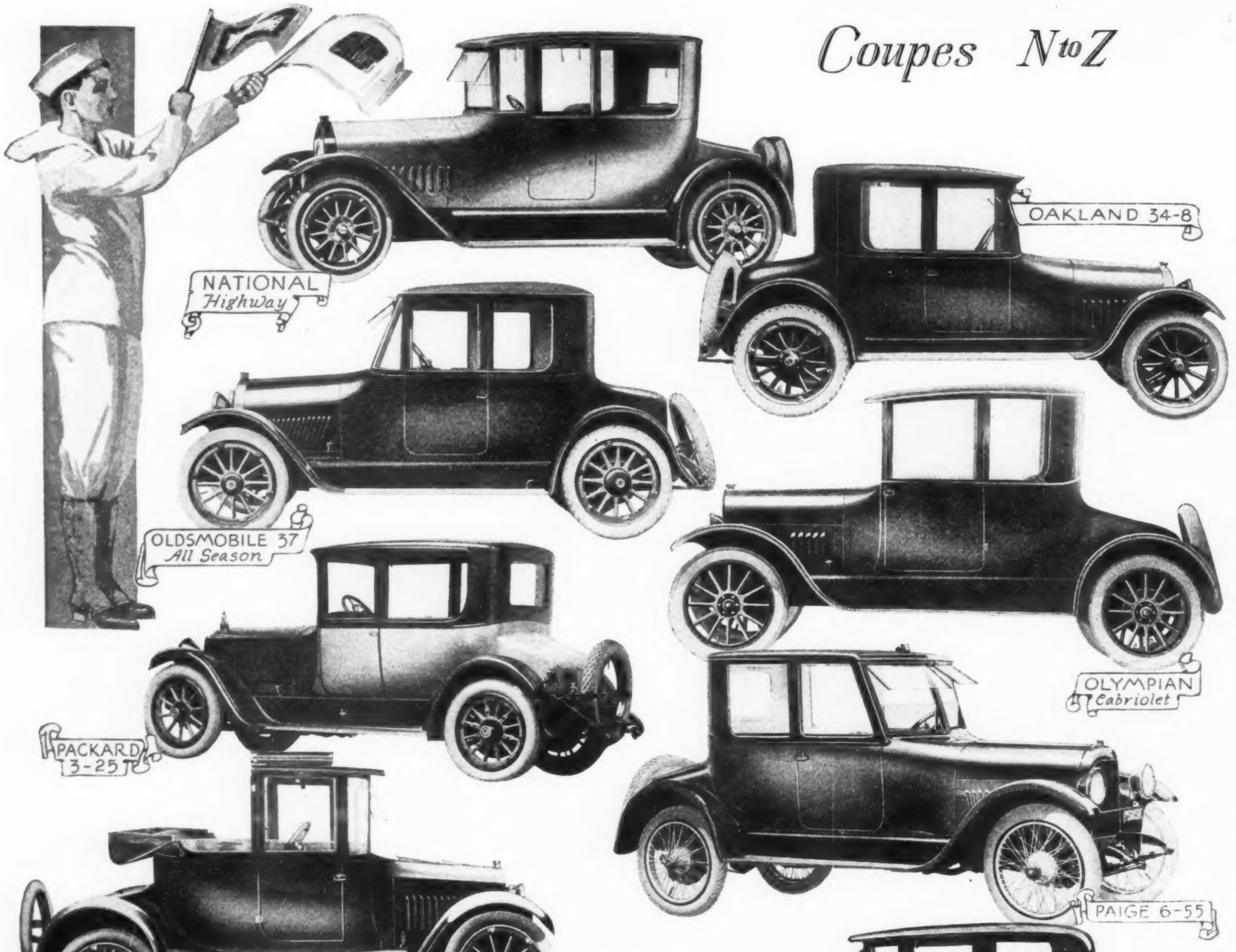


Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.



Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.

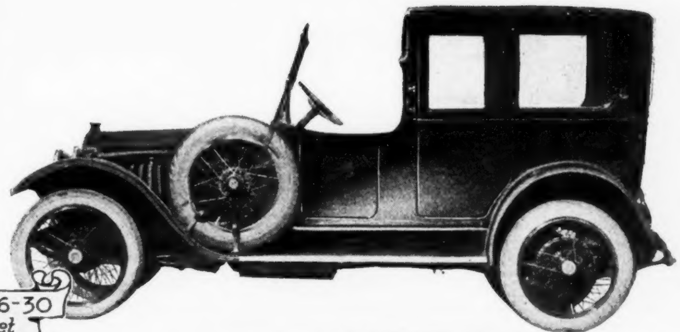
Coupes N to Z



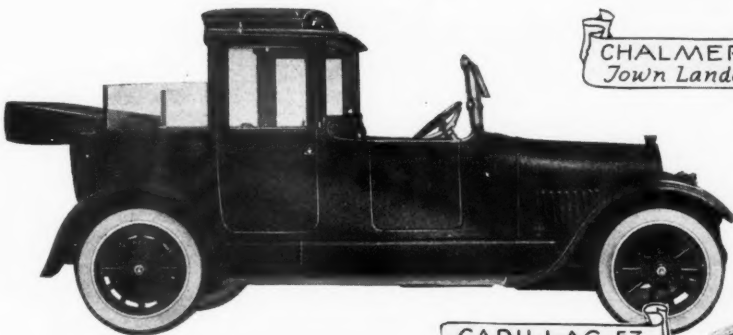
Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.

Landaulets

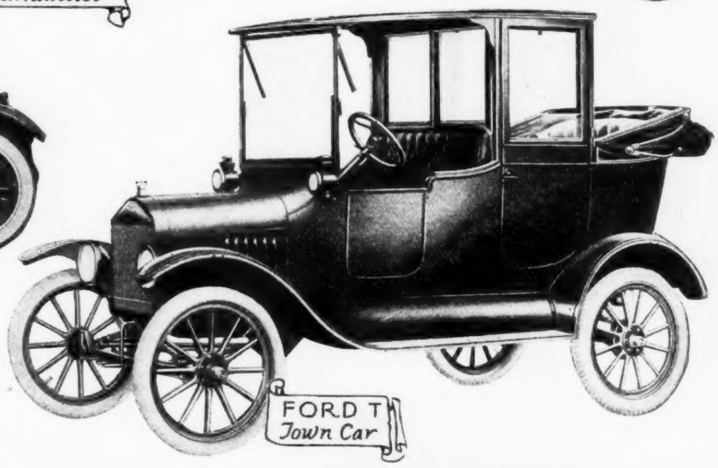
A to Z



CHALMERS 6-30
Town Landaulet

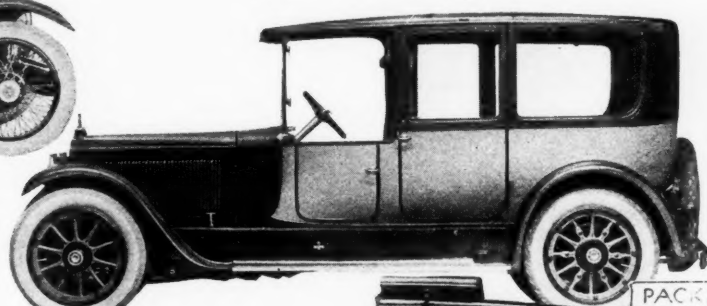


CADILLAC 57
Town Landaulet

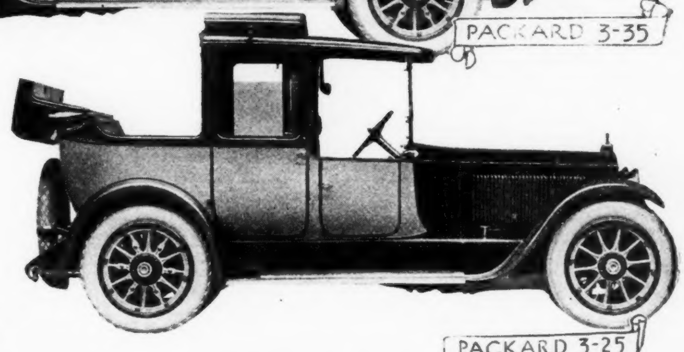


FORD T
Town Car

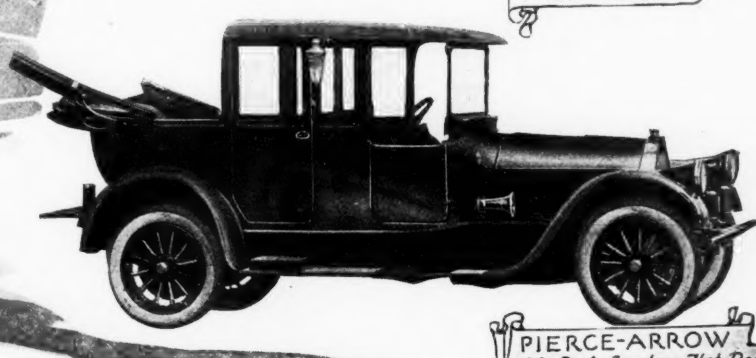
OWEN O-36



PACKARD 3-35

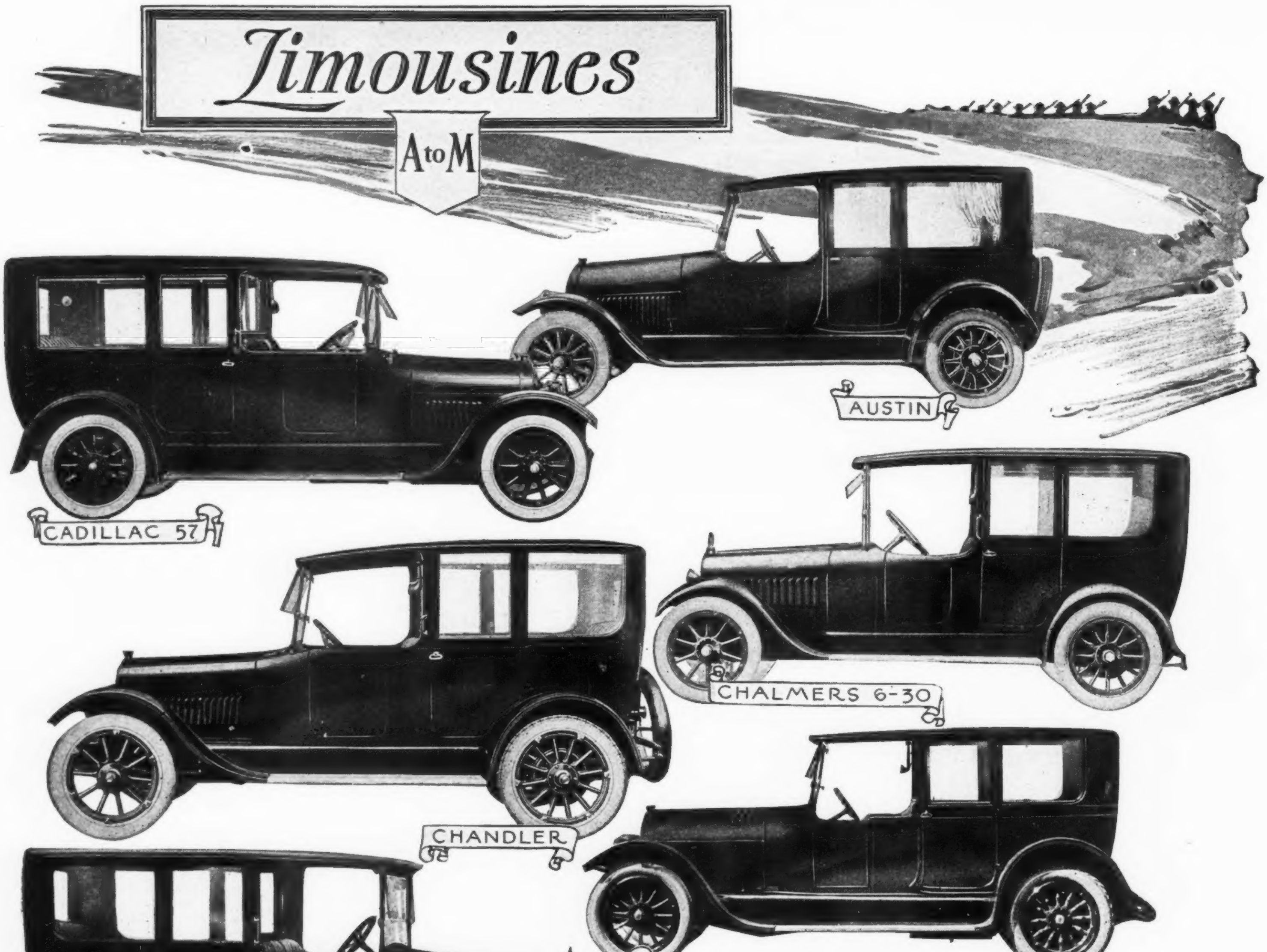


PACKARD 3-25



PIERCE-ARROW
48-B-4 Landau-Flat Roof

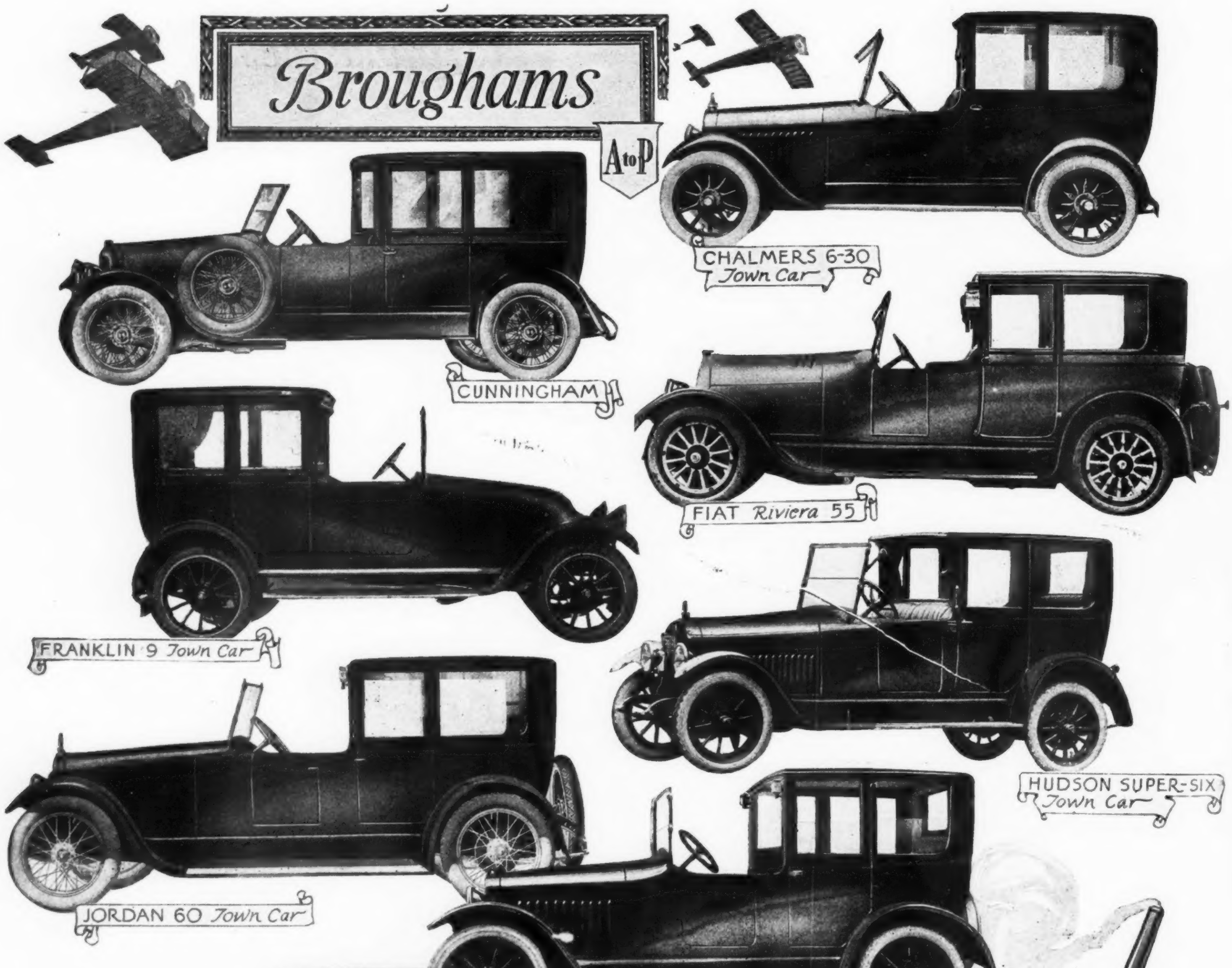
Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.



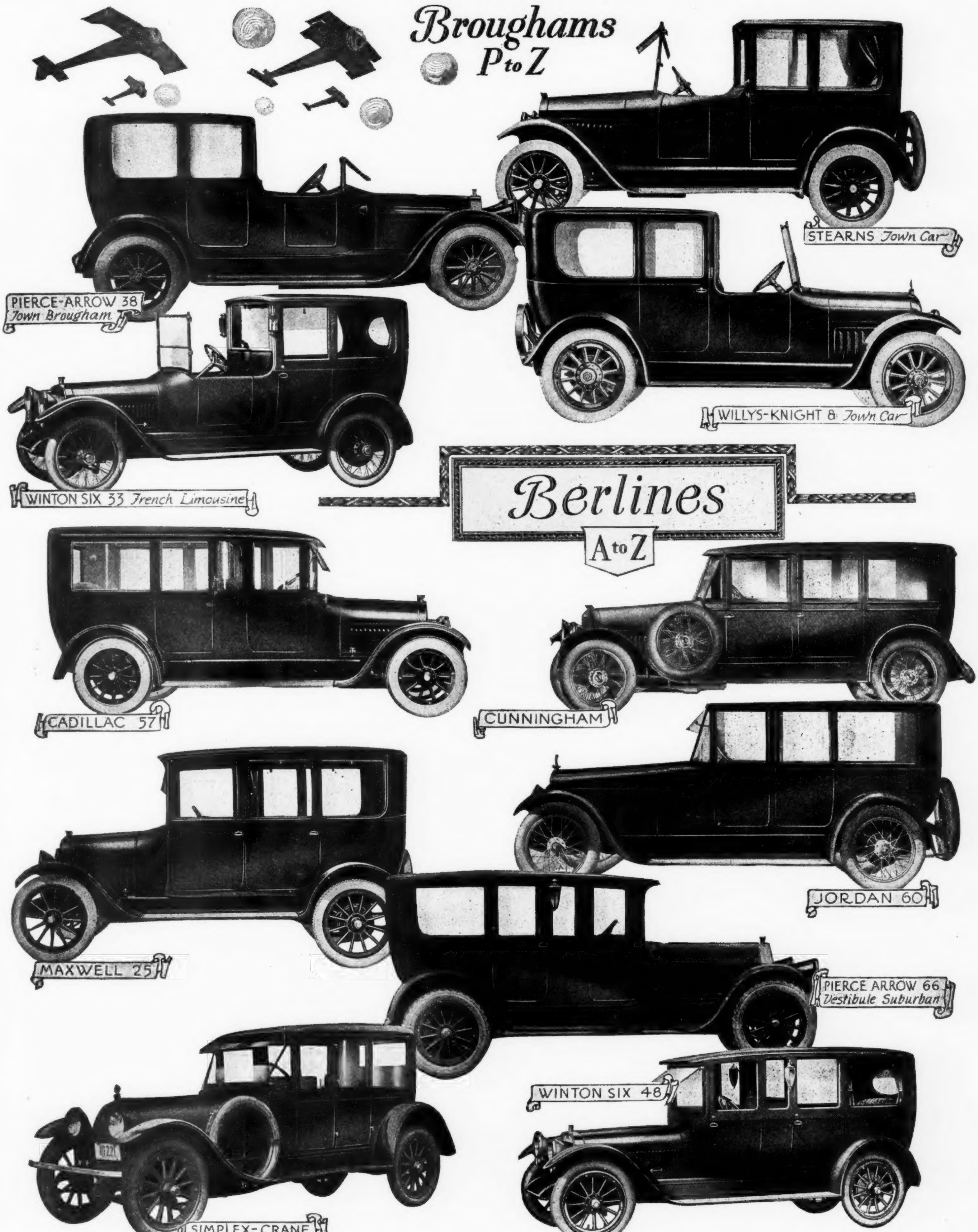
Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.

Limousines M to Z

Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.

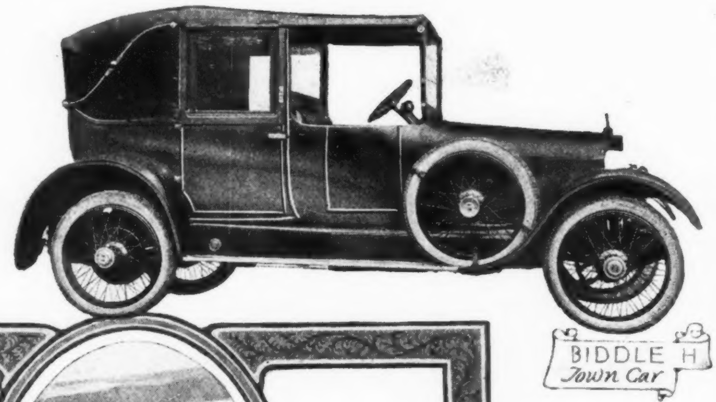


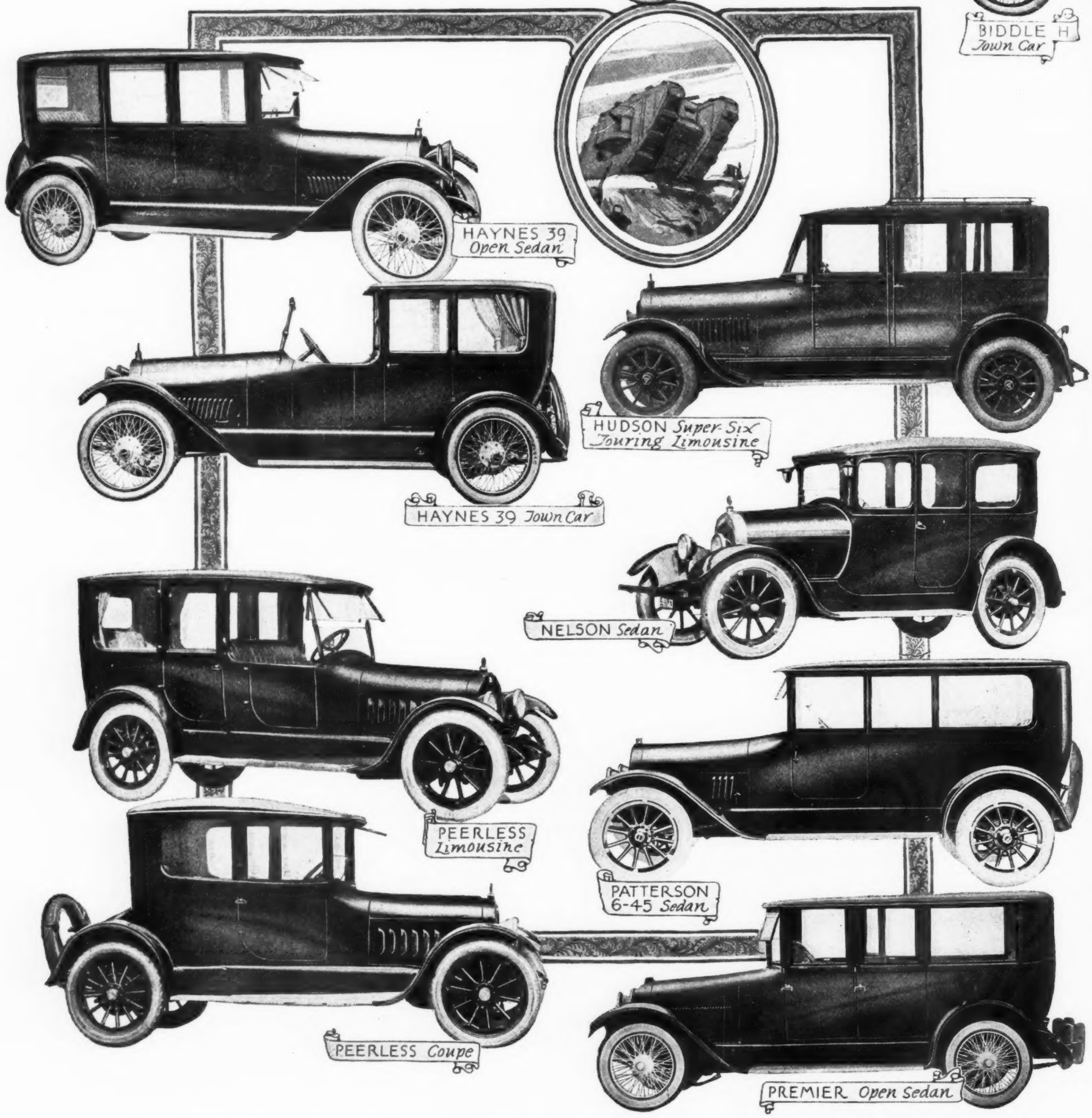
Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.



Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.

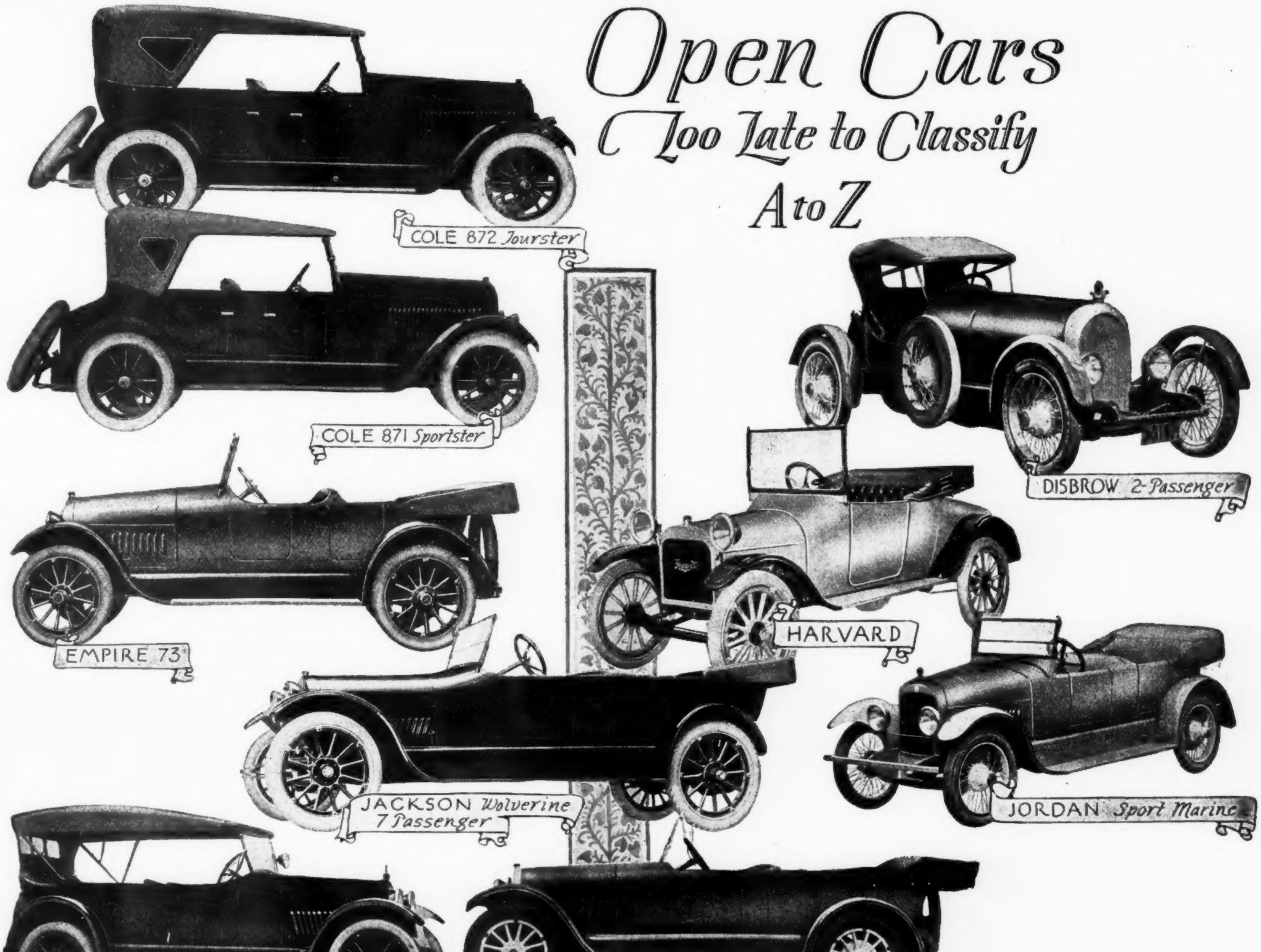
Miscellaneous Closed Cars A to Z





Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.

Open Cars
Too Late to Classify
A to Z



Specifications of these cars appear on pages 60 to 67; prices on pages 98 to 100.

Annual Buyers' Guide To America's Motor Cars

This is for reference and is to be used with the pictures of 1918 cars appearing on pages 70 to 97

SEVEN-PASSENGER TOURING CARS

Name and Model	Cyl.	Price
Abbott, 6-62	6	....
Anderson, 20	6	....
Apperson, 8-18-7	8	$2550
Apperson, 6-17-7	6	2200
Auburn, 6-44	6	1685
Buick, E-6-49	6	1495
Cadillac, 57	8	2805
Case, U	6	1875
Chalmers, 6-30	6	1535
Chandler, 25	6	1595
Chandler, 17-B		
Cole, 870 Tourster	8	2395
Cole, 860	8	1995
Crawford, 18-6-40	6	2250
Cunningham	8	4750
Davis, 6-J-18	6	1785
Davis, 6-H-18	6	1485
Deering Magnetic	6	3750
Dispatch, G	4	1250
Dorris, 1-C-6	6	2785
Empire, 70-A	6	1375
Fiat, E 17	4	5500
Fiat, 55	4	5500
Hal Twelve, 25	12	3600
Haynes, 39	6	1825
Haynes, 44	12	2785
Hudson Super-Six	6	1950
Jackson, Wolverine	8	1570
Jones, 26 A B	6	1675
Jones, 26 A B, Victoria	6	1775
Jordan, 60	6	1995
King, 8-EE	8	....
KisselKar, Double Six	12	2250
Lexington, R	6	....
Locomobile, 48	6	5950
Locomobile, 38	6	5000
Marmon, 34	6	3550
Marion-Handley, B-6-60	6	1850
McFarlan, Six	6	3500
Moline-Knight, G	4	1985
Moline-Knight, G. De Luxe	4	2250
Mitchell, C-42	6	1525
Moon, 6-66	6	1850
Moon, 6-45	6	1685
Murray	8	2800
Nash, 671	6	1465
National Highway, 6	6	1995
National Highway, 12	12	2595
Oldsmobile, 45-A	8	1467
Owen Magnetic, W-42	6	....
Owen Magnetic, O-36		3950
Packard, 3-25	12	3700
Packard, 3-25, Salon	12	3700
Packard, 3-25	12	4100
Packard, 3-35, Salon	12	4100
Paige, 6-55	6	1775
Pan American, J-7	6	1885
Paterson, 6-45	6	1295
Peerless, 56	8	2340
Pennsy, 6-18	6	1425
Pierce-Arrow, 48-B-4	6	5500
Pierce-Arrow, 66-A-4	6	6500
Premier, 6-C	6	2285
Reo, M	6	1385
Singer	6	3800
Standard, 8-G	8	2450
Stearns, SKL 4	4	$1785
Stearns, SK 8	8	2575
Studebaker, 6	6	1695
Stutz, S	4	2750
Velie, 39	6	1595
Westcott, 18	6	1940
White, GM	4	5000
Willys Six, 89	6	1365
Willys-Knight, 88-4	4	1525
Willys-Knight, 88-8	8	2000
Winton Six, 33	6	3000
Winton Six, 48	6	3500
Yale, 8-M	8	1650

SIX-PASSENGER TOURING CARS

Name and Model	Cyl.	Price
Austin Highway King	12	$3750
Cunningham	8	4750
Daniels, 8	8	3100
Locomobile, 38	6	5000
Locomobile, 48	6	5950
Stutz, S	4	2750
Winton Six, 33	6	3000
Winton Six, 48	6	3500

STEAMERS

Name and Model	Cyl.	Price
Doble-Detroit, 7-pass	2	$3750
Stanley, 5-pass	2	2400
Stanley, 7-pass	2	2500
Stanley, roadster	2	2400

FIVE-PASSENGER TOURING CARS

Name and Model	Cyl.	Price
Allen, 41	4	$1095
American, 6-B	6	1375
Anderson, 20	6	....
Arbenz	4	725
Auburn, 6-39	6	1395
Bell	4	995
Bour-Davis, 18-B	6	1650
Bour-Davis, 18-A	4	1385
Brewster, I	4	7700
Briscoe, 4-24	4	725
Buick, E-6-45	6	1265
Buick, E-4-35	4	795
Campbell	4	835
Chalmers, 6-30	6	1485
Chevrolet, D-4	8	1385
Chevrolet, 490	4	635
Chevrolet, F-A	4	935
Columbia, 6	6	1350
Comet, C-50	6	1285
Commonwealth, 4-40	4	995
Crawford, 18-6-40	6	2250
Crow-Elkhart, CE-36	4	935
Crow-Elkhart, CE-36, DeLuxe	4	995
Davis, 6I-18	6	1485
Dixie	4	995
Dodge	4	885
Dort	4	....
Elcar, 4	4	1095
Elcar, 6	6	1295
Elgin	6	1095
Empire, 50	4	1125
Empire, 70-A	6	1345
Fageol, custom built	6	....
Fergus, chassis only	6	....
Ford, T	4	360
Franklin, 9	6	2050
F. R. P. chassis only	4	....
Geronimo, 6-A-45	6	1395
Geronimo	4	$895
Ghent, 6-60	6	....
Glide, 6-40	6	1495
Grant, C	6	1055
Hackett, A-L	4	....
Harroun	4	785
Haynes, 38	6	1725
Hollier, 206	6	....
Hollier, 196	6	1085
Hollier, 188	8	1285
Hupmobile, R	4	1250
Inter-State, T	4	1000
Jackson, 8, Wolverine	8	1495
Kissel, 100-point	6	1295
Kline Kar, 6-38	6	1495
Lexington, R	6	1585
Liberty Six, 10-B	6	1350
Maibohm, B	6	975
Marion-Handley, B-6-60	6	1590
Marmon, 34	6	3500
Maxwell, 25	4	745
McFarlan, 125	6	3700
Metz, 25	4	695
Mitchell, D-40	6	1250
Mitchell, C-42	6	1510
Moline-Knight, C	4	1650
Monitor	6	1195
Monroe, M-6	4	995
Moon, 6-36	6	1195
Moore, 30	4	695
Nash, 681,583	6	1295
Oakland, 34-B	6	990
Oldsmobile, 37	6	1185
Olympian	4	965
Overland, 90	4	795
Overland, 85-4	4	930
Overland, 85-6	6	1130
Packard, 3-25, Phaeton	12	3700
Packard, 3-25, Salon Phaeton	12	3700
Paige, 6-39	6	1330
Pan American, G-5	6	1500
Paterson, 6-45	6	1265
Pennsy, 18	4	1035
Pennsy, 6-18	6	1335
Pierce-Arrow, 38-C-4	6	4800
Pierce-Arrow, 66-A-4	6	6400
Pierce-Arrow, 48-B-4	6	5400
Pilot, 6-45	6	1295
Princess, 4-36	4	875
Regal, J	4	795
Reo, R	4	985
Roamer, D-4-75	4	....
Roamer, 6-54	6	2095
Roamer, 6-45	6	1950
Roamer, 6-54	6	3250
Roamer, 6-45	6	3150
Saxon, S-4	6	935
Sayers, 6	6	1495
Scripps-Booth, 6-39		
Seneca, 6	4	850
Shad-Wyck, A and B	6	2650
Seneca, A		735
States, C-18	6	995
Stearns, SKL-4	4	1785
Stephens, 6, 75	6	1485
Studebaker, 6	6	1295
Studebaker, 4	4	895

Name and Model	Cyl.	Price
Templar, 445	4	$1985
Velie, 38	6	1340
Wescott, 18	6	1940
Westcott, S-18	6	1790
Winton Six, 33	6	2950
Winton Six, 48	6	3500

TWO-PASSENGER ROADSTERS

Name and Model	Cyl.	Price
Allen, 41	4	$1095
American, 6-B	6	1465
Austin	12	3750
Briscoe, 4-24, Runabout	4	....
Buick, E-4-34	4	795
Cadillac, 57	8	2805
Chalmers, 6-30	6	1485
Chevrolet, 490	4	620
Chevrolet, FA	4	935
Crawford	6	2250
Daniels, B	8	3100
Disbrow	4	2950
Dispatch, G	4	1150
Dodge	4	885
Empire, 51	4	1165
Ford, T, Runabout	4	345
Franklin, 9, Runabout	6	2000
Geronimo, 6-A-45	6	1260
Grant	6	1055
Hal, Twelve, 25	12	3600
Harvard	4	750
Homer-Laughlin, D	8	1050
Hupmobile, R	4	1250
Inter-State, T	4	950
Jackson Wolverine	8	1495
Kissel		
Kline Kar, 6-38	6	1495
Liberty Six, 10-B	6	1350
Maibohm, A. Sport	4	795
Maibohm, B	6	975
Maxwell, 25	4	745
McFarlan	6	3500
Mercer, Runabout	4	3400
Mercer, Raceabout	4	3250
Metz, 25	4	695
Mitchell, D-40	6	1250
Moore, 30	4	695
Monitor	6	1195
Murray	8	....
National, 6, Speedster	6	....
National, 12, Speedster	12	....
Nelson	4	1200
Oakland, 6, 34-B	6	990
Oldsmobile, 45-A	8	1467
Oldsmobile, 37	6	1185
Overland, 90	4	780
Peerless, 56, Sport	8	2490
Pierce-Arrow, 48-B-4	6	5400
Pierce-Arrow, 38-C-4	6	4800
Pierce-Arrow, 66-A-4	6	6400
Saxon, 4	4	445
Singer	6	4000
Standard, 8-G	8	2450
Stutz, S, Speedster	4	2550
Stutz, S	4	2550
Templar, 445	4	2255
Velie, 38	6	1340
Wolverine Speedway	4	3500
Winton Six, 33	6	2950
Winton Six, 48	6	3500
Yale, 8-M	8	1650

FOUR-PASSENGER ROADSTERS

Name and Model	Cyl.	Price
American Six, B, Cloverleaf	6	$1465
Apperson, 8-18-4, Chummy	8	2550
Apperson, 6-17-4	6	2200
Auburn, 6-39, Chummy	6	1345
Auburn, 6-39, Sport	6	1385
Auburn, 6-44, Chummy	6	1635
Austin Highway King	12	3750
Bell, Club	4	995
Bell, Special	4	1145
Biddle, H	4	2600
Bour-Davis, 18-A, Sport	4	1385
Briscoe, 4-24, Chummy	4	725
Case, 6, Sport	6	1875
Chalmers, 6-30, Duplex	6	1485
Chandler	6	1595
Chevrolet, 8	8	1385
Cole, 870	8	1995
Cole, 870	8	2395
Cole, 871, Sportster	8	$2395
Commonwealth, 4, Forty	4	995
Crawford	6	2250
Crow-Elkhart, CE-36, DeLuxe	4	995
Daniels, 8 Sportif	8	3100
Dispatch, Cloverleaf	4	1250
Dixie	4	995
Elcar, 4	4	1095
Elcar, 6	6	1295
Elgin	6	....
Empire	6	1360
Franklin, 9	6	2050
Ghent, 6-60	6	....
Glide, 6-40, Club	6	1395
Harvard	4	985
Haynes, 39	6	1825
Haynes, 44	12	2785
Inter-State	4	1025
Jackson Wolverine, Cruiser	8	1495
Jordan, J-60	6	1995
KisselKar, Double Six	12	2250
KisselKar, 100 Point	6	1385
Kline Kar, 6-38	6	1495
Lexington, 0, Clubster	6	1385
Liberty Six, 10-B	6	1350
Marmon, 34	6	3550
Marion-Handley, B 6-60	6	1850
McFarlan, Destroyer	6	3750
McFarlan, 124	6	3500
Moline-Knight, C	4	1650
Moline-Knight, G	4	1985
Monitor	6	1195
Moon, 6-66	6	1850
Moon, 6-36	6	1095
Moon, 6-45	6	1575
Moore, 30	4	695
Murray	8	2800
Nash 6	6	1295
National Highway, 6	6	1995
National Highway, 12	12	2595
Oldsmobile, 45-A, Speedster	8	1550
Oldsmobile, 45-A	8	1467
Olympian	4	965
Overland Country Club	4	840
Owen Magnetic, O-36	6	3950
Packard, 3-25, Runabout	12	3700
Paige, 6-39, Cloverleaf	6	....
Pan American, H-4	6	1500
Paterson, 6-45	6	1295
Peerless, 56	8	2340
Pennsy, 18	4	1035
Pennsy, 6-18	6	1335
Pierce-Arrow, 38-C-4	6	4800
Pierce-Arrow, 66-A-4	6	6400
Pierce-Arrow, 48-B-4	6	5400
Pilot, 6-45	6	1295
Premier, Foursome	6	2285
Reo, M	6	1385
Saxon, 6, Chummy	6	935
Standard, 8-G	8	2450
Stearns, SKL 4	4	1785
Stearns, SK 8	8	2575
Stutz, S	4	2650
Velie, 38	6	1340
Velie, 39, Sport	6	1850
Westcott, 18	6	1890
White, GMT, Runabout	4	5000
Winton Six, 33, Cloverleaf	6	2950
Winton Six, 48, Cloverleaf	6	3500
Yale Eight, M, Speedster	8	1650

LIMOUSINES

Name and Model	Cyl.	Price
Austin, Highway King	12	$5250
Brewster	4	8500
Cadillac, 57	8	4145
Chalmers, 6-30	6	2925
Chandler	6	2895
Dorris, I-C-6	6	4150
Fiat, 55	4	6500
Franklin, 9	6	3200
Hal Twelve, 25	12	5000
Hudson Super Six	6	3400
Locomobile, 48	6	7200
Locomobile, 38	6	6200
Marmon, 34	6	5250
McFarlan	6	4650
Mitchell, C-42	6	2850
Murray	8	4000
Owen Magnetic, W-42	6	$6300
Packard, 3-25	12	5250
Packard, 3-35	12	5650
Paige, 6-55	6	3230
Peerless, 56	8	3690
Phianna	4	....
Pierce-Arrow, 48-B-4, Suburban	6	6800
Pierce-Arrow, 38-C-4	6	5900
Premier, 6C	6	3285
Singer	6	4750
Standard, 8-G	8	4000
Stearns, SKL 4	4	3350
Stearns, SK 8	8	3985
White, GM	4	6200
Willys-Knight, 88-4	4	2325
Willys-Knight, 88-8	8	2800
Winton Six, 48	6	4500
Winton Six, 33	6	3950

BROUGHAMS AND TOWN CARS

Name and Model	Cyl.	Price
Biddle, H, Town Car	4	$4000
Biddle, H	4	3900
Brewster	4	8300
Cadillac, 57, Town Limousine	8	4160
Chalmers, 6-30, Town Car	6	2925
Cunningham	8	6000
Fiat, E-17	4	6500
Fiat, 55	4	6500
Franklin, 9, Town Car	6	3200
Hal Twelve, 21-A	12	4500
Hal Twelve, 25	12	5000
Haynes, 44, Town Car	12	3985
Haynes, 39, Town Car	6	3250
Hudson Super-Six, Town Car	6	3400
Jordan, 60, Town Car	6	3300
Liberty Six, 10-B	6	2700
Marmon, 34	6	5250
McFarlan, Town Car	6	4600
Mitchell, C-42, Tourer	6	2850
Paige, 6-55, Town Car	6	3230
Pierce-Arrow, 38-C-4	6	5900
Pierce-Arrow, 66-A-4	6	7600
Pierce-Arrow, 48-B-4	6	6600
Singer	6	5350
Stearns, Town Car	4	3400
Stearns SK 8	8	3875
Velie, 38	6	2450
White, GMT	4	6050
Willys-Knight, 8	8	2800
Winton Six, 33, French Limousine	6	3950
Winton Six, 48, French Limousine	6	4500

CONVERTIBLE COUPES

Name and Model	Cyl.	Price
Anderson, 20	6	....
Crow-Elkart, CE 36	3	$1195
Dodge	4	1050
KisselKar, Double Six Sedané	12	2800
KisselKar, 100 Pt. Six	6	1885
Lexington, O	6	1545
Maibohm, A	4	1095
Oakland, 34-B	6	1150
Pilot, 6-45	6	1520
Westcott, 18	6	2790

CONVERTIBLE SEDANS

Name and Model	Cyl.	Price
Auburn, 6-39	6	$1595
Auburn, 6-44	6	1985
Crow-Elkhart, CE-36	4	1275
Dodge, Winter Car	4	1050
Glide, 6-40	6	1795
Grant, G	6	1350
KisselKar, Double Six, Sedané	12	2650
KisselKar, 100 Pt. Six	6	1885
Liberty, 10-B	6	1625
Mitchell, D-40	6	1550
Paige, 39	6	1925
Pilot, 6-45	6	1945
Stearns, SKL-4	4	2535
Westcott, 18	6	2790
Winton Six, 33	6	4000

LANDAULETS

Name and Model	Cyl.	Price
Brewster	4	$8650
Cadillac, 57	8	4310
Cadillac, 57	8	4295
Chalmers, 6-30	6	3025
Chalmers, 6-30, Town Landaulet	6	3025
Ford, T, Town Car	4	595
Hudson, Super-Six	6	3500

Name and Model	Cyl.	Price
Hudson, Super-Six	6	$4252
Liberty, 6,10-B	6	2700
Locomobile, 48	6	7300
Locomobile, 38	6	6300
Marmon, 34	6	5350
Owen, O-36	6	5200
Packard, 3-25	12	5300
Packard, 3-35	12	5700
Pennsy, 6-18	6	1850
Phianna	4	....
Pierce-Arrow, 48-B-4	6	6800
Pierce-Arrow, 38-C-4	6	5900
Singer	6	4850
Stearns, SK8	8	3985
Stearns, SKL 4	4	3300
White, GM	4	6200
White GMT, Town Landaulet	4	6050
Winton Six, 33	6	4200
Winton Six, 48	6	4750

BERLINES

Name and Model	Cyl.	Price
Brewster, Inclosed Drive	4	$7900
Cadillac, 57, Imperial	8	4345
Cunningham, Inside Drive	8	6000
Hudson, Super-Six, Limousine	6	3150
Jordan, 60, Sedan	6	2650
Locomobile, 38	6	6400
Locomobile, 48	6	7400
Maxwell, 25	4	1095
McFarlan	6	4900
Packard, 3-35, Imp. Limousine	12	5850
Packard, 3-25, Imp. Limousine	12	5450
Pierce-Arrow, 66-A-4, Vestibule Suburban	6	8000
Simplex-Crane	6	10200
Winton Six, 33, Four-Door Lim.	6	4200
Winton Six, 48, Four-Door Lim.	6	4750

FOUR-PASSENGER TOURING CARS

Name and Model	Cyl.	Price
Abbott, 6-62	6	....
Apperson, 8-18	8	$2550
Biddle, H	4	2650
Cadillac, 57, Phaeton	8	2805
Cole, 8, 872, Tourster	8	2395
Columbia, 6, Sport	6	1450
Cunningham	8	4450
Cunningham	8	4250
Daniels, B	8	3100
Dorris, I-C-6	6	2735
Elgin, F	6	1095
Empire, 73	6	1360
Hal Twelve, 25, Touring Roadster	12	3750
Hudson, Super-Six, Phaeton	6	2050
Jackson, Wolverine Flyer	8	1575
Jordan, Sport Marine	6	2375
Jordan, 60	6	1995
King, 8, Foursome	8	....
Lexington, R, Spor Tour	6	1585
Locomobile, 48	6	6050
Locomobile, 38	6	5150
Maibohm, B, Phaeton	6	975
Mercer, Sporting	4	3500
Moore, 30	4	695
Murray	8	2800
National, 6, Sport Phaeton	6	1995
National, 12, Sport Phaeton	12	2595
Nelson	4	1400
Oldsmobile, 45-A, Sportster	8	1550
Packard, 3-25, Runabout	12	3700
Princess, 4-36-E	4	875
Scripps-Booth, H	8	1595
Shad-Wyck	6	2650
Singer, Sport Touring	6	4000
Stephens, Sport	6	1550
Templar, 445	4	1985
Templar, 445, Victoria	4	2155
Wolverine	4	3750
Willys Six, Club	6	1365
Winton Six, 48	6	3500
Winton Six, 33	6	2950

ODD-CAPACITY ROADSTERS

Name and Model	Cyl.	Price
Biddle, H, 3-pass	4	$2650
Buick, E-Six-44, 3-pass	6	1265
Chalmers, 6-30	6	1485
Davis, J1-18, 5-pass	6	1785
Davis, 1-18, 5-pass	6	1485
Dort, 11 3-pass	4	....
Grant, G, 3-pass	6	1055
Jones, 26 A B, 5-pass	6	1675
King, 18, 3-pass	8	....
KisselKar, 100 Point Six	6	$1295
Kline Kar, 6-38, 3-pass	6	1495
Maxwell, 25, 3-pass	4	745
Mitchell, D-40, Club, 5-pass	6	1280
Mitchell, C-42, 3-pass	6	1490
Mitchell, C-42, Club, 5-pass	6	1560
Monroe, M-3, Club, 3-pass	4	995
Oakland, 34-B, 3-pass	6	990
Overland, 85-4, 3-pass	4	915
Overland, 85-6, 3-pass	6	1115
Paige, 6-39, 3-pass	6	1330
Pierce-Arrow, 38-C-4, 3-pass	6	4800
Pierce-Arrow, 66-A-4, 3-pass	6	6400
Pierce-Arrow, 48-B-4, 3-pass	6	5400
Princess, 3-pass.	4	875
Reo, R, 3-pass	4	985
Scripps-Booth, G, 3-pass	4	935
States, C-18, 3-pass	6	995
Stephens 6-70, 3-pass	6	1485
Winton Six, 33, 3-pass	6	2950
Winton Six, 33, 3-pass Cloverleaf	6	2950

COUPES AND CABRIOLETS

Name and Model	Cyl.	Price
Abbott, 6-62	6	....
Buick, E-6-46	6	$1695
Cadillac, 57	8	3205
Chalmers, 6-30, Cabriolet	6	1775
Chandler, 25	6	2195
Chevrolet, 490	4	1060
Cunningham, cabriolet	8	6000
Deering Magnetic	6	4350
Dispatch	4	1400
Dodge	4	1350
Dorris, I-C-6	6	3325
Ford, T	4	560
Franklin, 9, Cabriolet	6	2850
Franklin, 9, Brougham	6	2900
Grant, G	6	1575
Haynes, 39	6	2535
Haynes, 44	12	3335
Jordan, 60, Brougham	6	3000
Maibohm, A	4	1095
Maibohm, B, Cabriolet	6	1375
Maxwell, 25	4	1095
Mitchell, D-40	6	1850
Mitchell, C-42, Cabriolet	6	1960
Mitchell, C-42	6	2135
Moon, 6-66	6	2550
Moon, 6-66, Cabriolet	6	2350
Moon, 6-45, Cabriolet	6	2350
Murray	8	3600
National Highway, 6	6	2645
National Highway, 12	12	3245
Oakland, 34-B	6	1490
Oldsmobile, 37	6	1595
Olympian, Cabriolet	4	1340
Overland, 85-6	6	1420
Overland, 85-4	4	1285
Packard, 3-25	12	5050
Paige, 6-55	6	2850
Peerless, 56	8	2850
Phianna	4	....
Pierce-Arrow, 38-C-4	6	5700
Pierce-Arrow, 66-A-4	6	7400
Pierce-Arrow, 48-B-4	6	6400
Standard, 8-G	8	3500
Stearns, SKL 4	4	2400
Stearns, SK 8	8	3200
Stutz, S	4	3250
Velie, 38	6	1900
Velie, 38, Cabriolet	6	1850
White	4	6050
White, G. M. Cabriolet	4	6400
Willys-Knight, 88-4	4	2175
Winton Six, 33	6	3950
Winton Six, 33, Coupelet	6	3265
Winton Six, 48	6	4500
Winton Six, 48, Coupelet	6	3750
Woods Dual Power	4	2950

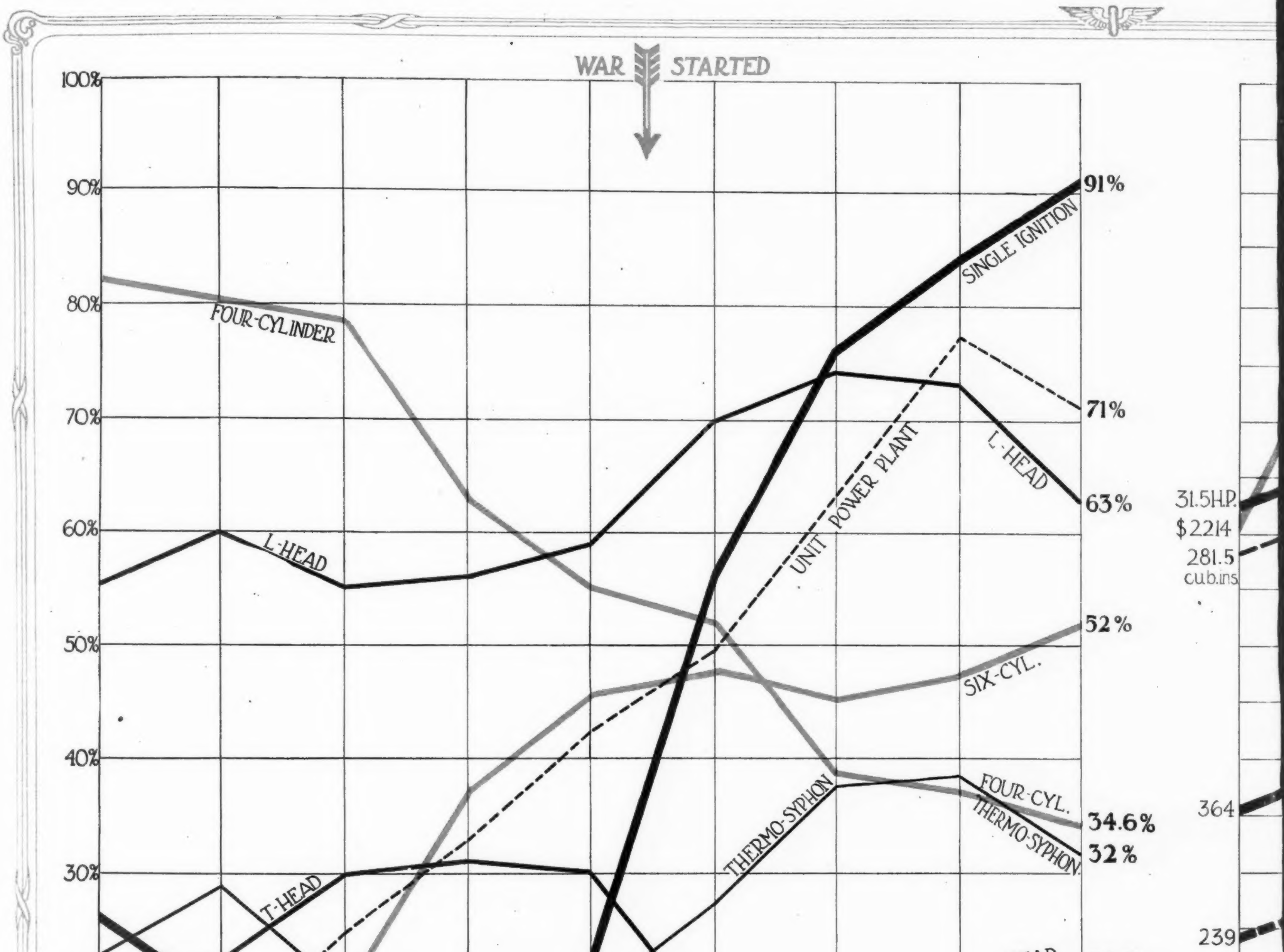
SEDANS

Name and Model	Cyl.	Price
Anderson, 20	6	....
Apperson	8	$3400
Auburn, 6-44	6	2450
Austin	12	4950
Biddle, H	4	4100
Briscoe, 4-24, Coachaire	4	850
Buick, E-6-50	6	2175
Cadillac, 57, Brougham	8	$3650
Chandler, 25	6	2295
Comet	6	2150
Chevrolet, FA	4	1475
Crawford	6	2750
Daniels, B, Suburban Berlin	8	....
Davis, K-18	6	1850
Deering Magnetic	6	4500
Dispatch, G	4	1500
Dorris, I-C-6	6	3350
Dort, II	4	1095
Elcar, 4	4	1625
Elcar, 6	6	1795
Empire, 70-S	6	1685
Ford, T	4	695
Franklin, 9	6	2950
Ghent, 6-60	6	....
Hackett	4	....
Inter-State, T	4	1325
Jones, 26, A. B.	6	2550
Jordan, 60, Sport Limousine	6	3500
Liberty, 6, 10-B	6	1925
Marmon, 34	6	4950
Maxwell, 25	4	1095
McFarlan	6	4600
Moline-Knight, L	4	2280
Monroe, M-6	4	1850
Moon, 6-66	6	2650
Nelson	4	1800
Owen Magnetic, W-42	6	6300
Packard, 3-25, Brougham	12	5300
Packard, 3-25, Brougham	12	5400
Packard, 3-35, Brougham	12	5800
Paterson, 6-45	6	1795
Pennsy, 6-18	6	2250
Pierce-Arrow, 38-C-4	6	5900
Saxon, S-4	6	1395
Templar, 445	4	....
White, GMT	4	6050
Winton, Six, 33	6	4200
Winton Six, 48	6	4750

OPEN SEDANS

Name and Model	Cyl.	Price
Case, All Season	6	$2375
Chalmers, 6-30, Tour.-Sedan	6	1950
Chevrolet, 490	4	1060
Chevrolet, FA	4	1475
Cole 8, Toursedan	8	....
Columbia, 6, Tour.-Sedan	6	....
Davis, 6K-18	6	1850
Dodge	4	1350
Dort 11, Sedanet	4	....
Elgin, A	6	1645
Grant, G	6	1595
Hal Twelve, 25	12	4500
Haynes, 39	6	2585
Haynes, 44	12	3385
Hudson, Super-Six	6	2750
Jackson Wolverine	8	2195
Jordan, 60	6	2750
King, EE	8	....
Kline Kar, 6-38	6	2195
Maibohm, B	6	1375
Marion-Handley, 6	6	....
Maxwell, 25	4	1095
Mitchell, D-40, Tour.-Sedan	6	1950
Mitchell, C-42, Tour.-Sedan	6	2275
Mitchell, C-42, Club Sedan	6	2185
Moon, 6-66	6	2650
Murray	8	4000
Nash, 6	6	1985
National, 6, Tour.-Sedan	6	2820
National, 12, Tour.-Sedan	12	3420
Oakland, 34-B, Tour-Sedan	6	1190
Oldsmobile, 37, All Season	6	1695
Olympian	4	1565
Overland, 90, Tour.-Sedan	4	1240
Overland, 85-6, Tour.-Sedan	6	1620
Paige, 6-39	6	....
Paige, 6-55	6	2850
Peerless, 56	8	2990
Premier	6	3285
Reo, M	6	1950
Standard, 8-G, Touring Sedan	8	3500
Stephens, 6	6	1985
Velie, 38	6	1885
Westcott, 18	6	2790
Willys Six, Tour.-Sedan	6	2045
Willys-Knight, 88-8, Tour.-Sedan	8	2700

Trends of the American Automobile for 8 Years, Important Factors in Design and



8 Years, Showing Variations of Most
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